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New Year Opens With Improved Conditions

Steel Corporation Will Soon Have Ninety Per Cent of Capacity in Operation—Crude Steel Advances—Ore Sales in the East

Cheerful sentiment prevails in the iron and steel trade at the opening of the new year. While naturally there has been some decrease in buying during the period of holidays and inventory taking, all sections report that December made a most gratifying record in pig iron sales and in most finished products conditions were satisfactory. Evidences of keen competition at times, however, serve as warning not to expect too confidently that the coming months will be entirely free from unfavorable conditions. For example, the appearance of prices about $5 below recent quotations on steel boiler tubes is an indication that some manufacturers are not convinced that buying by railroads and other consumers will be very heavy. The production of pig iron by the Steel Corporation has steadily increased and within a few days all the workable furnaces in the Pittsburgh district will be in operation. It is expected that at an early date about 90 per cent of the blast furnace and mill capacity of the Corporation will be active. Unfortunately, some of the independent companies, particularly in the eastern territory, are operating at only about 60 per cent.

Iron Ore

Following the recent sale of 150,000 tons of eastern ore, a sale of 75,000 tons of Wabana, Newfoundland, ore is announced. In neither case was the price made public. Sellers of Lake Superior ore have taken no concerted action, but are giving a good deal of thought individually to the problem which confronts them of adjusting ore prices in harmony with reductions in ore freight rates on the Minnesota railroads, without giving Mesabi ores undue advantage. In spite of uncertainties prevailing, the Lake Superior producers expect to have a considerably better year than that of 1910.

Structural Material

Very little contracting for structural material is being done at present, but prices are being well maintained. During the year, a heavy tonnage of steel will be required in New York, including 70,000 tons for elevated construction and at least 100,000 tons for subway work. The subway project in Cleveland is assuming more definite shape and it seems probable that orders for from 18,000 to 20,000 tons of steel will be placed before the end of the year. Among recent awards were 40,000 tons for the Hell Gate bridge and 2,700 tons for New York terminal work, to the McClintic-Marshall Construction Co.; 5,000 tons for a loft in New York City, to an independent shop, and 5,800 tons for the Auerbach Candy Factory, New York, to the Hay Foundry & Iron Works. The Eastern Steel Co. will furnish and fabricate 3,000 tons for the Eddystone, Pa., addition to the Baldwin Locomotive Works.

Crude Steel

The price of crude steel has advanced and the leading interest is now asking $28, Pittsburgh, for forging billets, but $26 can still be done on desirable tonnages. Prices of rolling billets and sheet bars are firmer. A locomotive company has placed an order for 15,000 tons of billets and considerable tonnage is being inquired for by other users. Many of the leading buyers are covered by contracts.

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HEAVY TONNAGES

On Books of Pittsburgh Mills—Deep Cutting on Boiler Tubes.

Pittsburgh, Jan. 2. (By wire.)—The new year opens with steel mills in this section operating on very satisfactory schedules and with heavy tonnages on their books for delivery over the first half. Liberal specifications have been received during the past week and there is every indication that production in finished lines in January will be very heavy. Continued liberal buying by the railroads is expected. Car orders placed during the week include 2,500 gondolas for the Burlington, of which 1,500 will be built by the American Car & Foundry Co. and 1,000 by the Pressed Steel Car Co.; 500 box cars to be built by the Standard Steel Car Co. for the Missouri Pacific, and 100 cars to be built by the Pressed Steel Car Co for the Woodward Iron Co., Birmingham, Ala. The Standard Steel Car Co. will place its plant in full operation this month, and the Pressed Steel Car Co. will increase operation to about 75 per cent of capacity. The leading interest this week is quoting 1.20c, Pittsburgh, as the minimum on plates, shapes and bars, but other mills continue to quote $1 a ton under this price. It is stated today that prices on wire products and merchant pipe will not be advanced until Jan. 15, and it is doubtful whether new cards will be issued at that time.

The market on boiler tubes was very weak and further concessions of 2½ points, or $5 a ton, from the card issued during the third quarter is being offered by some companies, although this price is not general. The largest structural award was 40,000 tons of plates and shapes for approaches to the Hell Gate bridge given to the McClintic-Marshall Construction Co. The contract for the steel has not yet been placed, but will go to a local mill. Bids closed today on the Carnegie Technical school addition, Pittsburgh, involving 700 tons. The National Tube Co. received the contract for 125 miles of 12-inch steel line pipe from a southern California interest. The sheet and tin plate mills are operating at about 80 per cent of capacity and operations will be extended later in the month. Most large buyers are now under contract for first half; prices are fairly firm.

The coke market continues very firm at the higher prices reported last week. Prompt furnace coke has sold in small lots today at $1.80, ovens. It is understood that the H. C. Frick Coke Co. and the W. J. Rainey Coke Co. will start between 2,000 and 2,500 additional ovens this month.

Prices of old material are firmer, but not any higher. A local steel company has taken an additional 5,000 tons of heavy melting steel, making its total purchases during the past two months between 30,000 and 40,000 tons. The Pennsylvania railroad is taking bids on between 30,000 and 40,000 tons of scrap.

BASIC INQUIRY

Will Test Prices—Pittsburgh and Allegheny Buyers in Market.

Pittsburgh, Jan. 2. (By wire.)—The report that the Pittsburgh Steel Co. has closed with a nearby furnace for approximately 50,000 tons of basic pig iron for delivery to Monessen, Pa., over the first half is not confirmed, but the company is expected to close for this amount within a day or two. This transaction is likely to develop a lower price than that at which sales have been made during the past two weeks. An Allegheny valley steel company is also taking bids on 6,000 tons of basic for delivery over the first six months. The Westinghouse Machine Co. has closed for 2,000 tons of foundry grades. The Carnegie Steel Co. is operating 40 of its 59 blast furnaces and will blow in additional stacks within the next two weeks.

The basic average for December as announced by a local authority is $12.44, valley, compared with $12.27, valley, for November. The Bessemer average for December is given as $14.19, valley, compared with $14.01, valley, for November.

NEW COMPANY FORMED

By Bondholders of Hamilton Iron & Steel Co. By Buying Plant.

The committee of bondholders of the Hamilton Iron & Steel Co., Hamilton, O., which purchased that plant at the trustee's sale for the benefit of the bondholders last Dec. 14, have formed the Miami Iron & Steel Co., the incorporation of which was recently noted. The organization was perfected by the election of the following officers: President, E. M. Peters; vice president, Edwin N. Ohl, and secretary, E. C. Siemer. It is proposed to make such repairs to the plant as are necessary at the present time, and to hold the furnace ready for operation when the market warrants.

MUCH STEEL NEEDED

In East for Construction During the New Year.

New York, Jan. 2. (By wire.)—The outlook at the beginning of the new year is that a heavy tonnage of steel will be required for construction work in the metropolis during the year. The largest requirement will be for subway and elevated railway extensions, as difficulties in these projects are now clearing and most of this work will probably be put under construction over the year. For elevated extensions alone, about 70,000 tons will be needed, while the remaining subway work proper will easily add 100,000 tons additional.

Plain and fabricated material prices are still ruling low. Shapes are openly quotable at 1.15c, Pittsburg, or 1.30c, New York, and reports of lower levels are current. The lowest prices apparently are coming from mills not so well booked, chiefly in the east.

Late awards include 5,000 tons for the Bing & Bing loft, to an independent shop; 2,700 tons for two additional areas of New York Central terminal work to the McClintic-Mafshall Construction Co.; 900 tons for Cooper Union school to Milliken Bros., Inc.; 900 tons for Building & Engineering Co. loft to Hinkle Iron Works; 500 tons for Baron De Hirsch school to Hay Foundry & Iron Works, all of this city; 400 tons for American Sugar Refining Co.'s kiln house, South Boston, to the Boston Bridge Works; 450 tons for University Club, Washington, to Barber & Ross; 250 tons for Monumental Brewery, Baltimore, to Deitrich Bros.; 250 tons for Bowdoin college gymnasium, to the New England Structural Co. The Baltimore & Ohio has plans out for a lift bridge at Chicago, requiring 12,000 to 15,000 tons of steel.

The Auerbach candy factory, this city, has gone to the Hay Foundry & Iron Works and the full requirements of 5,800 tons will be furnished. The Eastern Steel Co. will furnish 3,000 tons of shapes and will be the fabricator for the Eddystone, Pa., additions to the Baldwin Locomotive Works. The Central Railroad of New Jersey has plans out for a pier in this city calling for about 1,000 tons. Bids have gone in for 5,000 tons for a southern New England railroad.

Great Northern Buys Rails

New York, Jan. 2. (By wire.) —The Great Northern has just closed an order for 36,000 tons of rails, which will be distributed among the United States Steel Corporation and various independent companies.

FURNACES FILLED

With Business and Pig Iron Quietness is Expected.

New York, Jan. 2. (By wire.)—The pig iron market in the metropolitan and surrounding districts is closing the year with customary quietness. Recent selling activity has filled up furnaces comfortably several months ahead and this is occasioning more general firmness in prices, but concessions are still obtainable. The tidewater market for No. 2X continues within the range of $14.50 to $15 and the New England market at $15.25 to $15.95. A railway equipment maker inquires for 1,000 to 1,500 high silicon foundry iron for Chicago shipment for first half. A leading pump interest's inquiry for about 6,000 tons of foundry grades is still pending.

A Bridgeport, Conn., consumer has closed for 3,000 tons of basic iron with a Lehigh valley maker for first quarter. Basic prices in the east are a little firmer and the market is more squarely quoted at $14.25 to $14.50, delivered. Some makers who have shaded these prices are less inclined to make concessions. A Utica pipe foundry is out for 2,000 tons of lower grades for first half, and an up-state valve manufacturer is inquiring for 1,000 tons.

Virginia Furnaces Cover First Half Coke Needs

New York, Jan. 2.—Virginia furnace interests are making contracts for their first half coke requirements. One furnace has closed with a maker in the Pocahontas district for first half shipments, aggregating 20,000 to 25,000 tons at about $1.60, ovens. Another Virginia consumer is about to close on requirements of approximately equal size and this business will likely go to the Pocahontas field, where quotations range from $1.60 to $1.65, ovens. The American Locomotive Co. is inquiring for its first half requirements of foundry coke, about 7,000 tons.

Schwab Testimonial Dinner

Invitations have been issued for the testimonial dinner in honor of Charles M. Schwab, president of the Bethlehem Steel Corporation, to be given Jan. 11 at the Bellevue-Stratford hotel, Philadelphia, under the auspices of the iron and steel manufacturers, who are affiliated with the Manufacturers' Club, of that city. The affair is in charge of a committee composed of iron and steel manufacturers of the east, with James W. Nagle, of the club, as the active secretary. It is expected that there will be a large representation of leading iron and steel makers of the country at the dinner. Last year, under similar auspices, a largely-attended testimonial dinner was tendered at the Manufacturers' Club to John Fritz, the veteran iron master.

MARKET HEALTHY

And More Active in Chicago Than in Past 18 Months.

Chicago, Jan. 2. (By wire.)—The year ends with the western market in a healthy condition and much more active than it has been for 18 months past. Neither producers nor consumers, however, are looking for a boom and all agree that great caution and discretion are necessary. Prices, excepting on wire goods, are in good shape and are especially firm on plates and structurals. Plates are now held at a minimum of 1.33c, immediate shipment, and contracts are being made only at 138c, Chicago, thus fully recognizing the Pittsburgh base.

Pig iron is quieter on account of the holidays, but it is estimated that only half of the tonnage requirements in this district for first quarter has been covered by contracts. Considerable buying is expected this month. Southern iron is now firm at $14.35, Chicago, for No. 2 for first half, with some furnaces obtaining 25 cents more for second quarter. Northern No. 2 foundry is steady at $14, furnace, for first half. Sales of this grade last week totaled about 15,000 tons. No material advances in pig iron prices are expected in this market immediately.

The only fabricating contract reported let in this district is a Chicago fire engine house, 138 tons, to George E. Laubenheimer.

Rail Sales

New York, Jan. 2. (By wire.)—The Southern railroad has placed approximately 21,500 tons of open-hearth rails with the Tennessee Coal, Iron & Railroad Co. The Dakota, Minnesota & Western railroad has bought 2,000 tons of rails from the Illinois Steel Co.

Billets Sold to Locomotive Co.

New York, Jan. 2. (By wire.) — A locomotive builder has closed for 15,000 tons of forging billets for first half shipment to different plants. The business is understood to have gone to Pittsburgh mills.

WELL FILLED BOOKS

With Eastern Furnaces—Heavy Sales in December.

Philadelphia, Jan. 2.—December sales of pig iron in the market have continued very heavy and those eastern and central Pennsylvania furnaces which are in operation are now well sold up at the beginning of the new year, in some cases for the full first quarter. Several local selling houses report their December booking as the largest in about two years, though a considerable portion of this business has gone to Virginia, southern and New York State furnaces, and some of the tonnage has been for consumption in New England and other outlying districts. One Lehigh Valley seller entered about 30,000 tons in December in eastern and central Pennsylvania territory. Only a very small amount of basic is included in the December sales in this district, which is of significance in showing the narrowed market for this grade in the east. The pipe foundries have bought liberally. One Delaware river shop has just closed for 5,000 tons of forge and No. 3 for March shipment, part of which went to southern furnaces at $9.25, Birmingham, for forge, or approximately $14.50, delivered. The purchases of another pipe buyer in December are reported as 10,000 to 15,000 tons. An eastern steel company continues in the market for 4,000 tons of Bessemer and 2,000 tons of low phosphorus iron for shipment to May, and for 300 tons of spiegeleisen for first half. It is expected to buy the Bessemer from an eastern steel company in the range of $15.50 to $15.75, delivered, at about $15, furnace. Recently this consumer bought about 1,000 tons of early shipment Bessemer around $15.75, delivered. A lot of 3,000 tons of southern basic for first quarter has been sold in the east for St. Louis district, shipment at $10, Birmingham. The Baltimore & Ohio railroad has bought 1,000 tons of No. 1 and No. 2X Virginia for first quarter shipment at Baltimore at about $14.65, delivered, or $12, furnace. Generally, Virginia makers are asking a minimum of $12.25, furnace, for No. 2X. Standard eastern Pennsylvania No. 2X is quoted within the range of $14.75 to $15, Philadelphia and vicinity. One Lehigh Valley maker is selling very aggressively. Basic is nominally quoted at $14.25, delivered, though lower has been done. The New York State maker has advanced low phosphorus iron 50 cents a ton to an equivalent of $19.75 to $20.25, Philadelphia. The West End, Virginia, furnace has gone in, the Temple stack is about to be lighted and the Sheridan furnace may also soon resume.

Year of Low Prices Ends With Bright Prospects

Cut of the Republic Iron & Steel Co. on Steel Bars Following by General Reductions—Decided Change for the Better in December

By L P Sutter

The decline in prices, which began early in 1910, continued throughout the first 11 months of the year just closed with the result that at the end of that period prices of iron and steel were lower than at any time in the history of the trade, based on present costs of labor and raw material. The preceding year also witnessed a big drop in prices, but the average prices for the 12 months were such as to give most manufacturers a profitable year. In volume of business, the year 1911 was fairly satisfactory, as conditions existing during the initial month did not indicate heavy buying in any branch. At the opening of the year, it was the disposition among the leaders in the trade to look for a reversal of the course of 1910, and the expectation was that at the end of 1911 conditions would be more favorable that at the beginning of the year. At the close of the year, it was generally conceded that the turn had come, with prospects for the future very bright.

As in times of industrial depressions in preceding years, numerous explanations have been offered as to the cause of the nervous and unsettled condition of the steel trade during the year, when basic conditions were considered sound, but perhaps never before has it been so evident in the opinion of conservative business men, that industrial advancement in this country has been delayed by the disturbances created by agitators and government attacks against legitimate business enterprises. Other reasons advanced for the unsatisfactory year are the failure of the country to absorb the increased output of the steel mills and the attitude of the railroads, following the adverse decision on freight rates handed down by the interstate commerce commission early in the year.

When the year opened, the steel industry was operating in the neighborhood of 50 per cent of capacity, with consumers limiting purchases to cover actual needs, and it was evident at that time that the reactionary movement had not fully run its course. The price situation was anything but satisfactory and there was grave danger of a general reduction in wages on account of the low prices prevailing at that time and prospects of a further general reduction in prices before the close of the initial month. A general meeting of iron and steel manufacturers was held in New York on Jan. 11, and at that time it was decided that lower prices would not bring out a larger volume of business. During the first quarter, there was no important change in the price situation, although concessions had been frequently offered in some branches. On May 24, the Republic Iron & Steel Co. surprised the trade by announcing a cut of $3 a ton on steel bars, thus declaring an open market. On June 1, there was a general reduction in prices, as follows: Billets and sheet bars, $2 a ton; steel bars, $3 a ton; black and galvanized sheets, $4 a ton; plates and shapes, $1 a ton. Prices continued to sag and each month brought lower quotations in practically every branch of the trade, except steel rails. A curious fact in the price fluctuations was that in the case of many commodities the very lowest prices found in the whole movement developed just as the upward movement was about to start. A general price stiffening throughout the trade showed itself very late in November and within two or three weeks prices on semi-finished steel, steel bars, plates, shapes, sheets and wire products were advanced from $1 to $2 a ton. Late in November and early in December, orders for steel products were heavier than at

AVERAGE MONTHLY PRICES, IRON AND STEEL PRODUCTS, PITTSBURGH, 1911

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Bessemer pig iron	$15.90	$15.90	$15.90	$15.90	$15.90	$15.90	$15.90	$15.90	$15.90	$15.39	$15.10	$15.15
Basic pig iron	14.40	14.46	14.46	14.46	14.32	14.12	13.77	13.90	13.70	13.42	13.37	13.26
No. 2 foundry	14.65	14.65	14.75	14.77	14.65	14.50	14.40	14.40	14.40	14.40	14.06	13.70
Gray forge iron	14.09	14.15	14.15	14.15	14.02	13.90	13.90	13.90	13.90	13.84	13.60	13.46
Malleable pig iron	14.40	14.52	14.65	14.65	14.55	14.15	14.15	14.15	14.07	13.85	13.40	13.59
Ferro-manganese	38.12	39.57	39.30	38.57	38.45	38.45	38.57	38.75	38.45	38.64	39.45	41.70
Bessemer billets, 4 x 4	23.00	23.00	23.00	23.00	23.00	21.00	21.00	21.00	21.00	20.00	19.70	19.25
Rails (standard)	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c	1.25c
Beams and channels, 15 inches and under	1.40c	1.40c	1.40c	1.40c	1.40c	1.35c	1.35c	1.35c	1.35c	1.32c	1.20c	1.14c
Tank plates	1.40c	1.40c	1.40c	1.40c	1.40c	1.35c	1.34c	1.30c	1.27c	1.20c	1.11c	1.15c
Steel bars	1.40c	1.40c	1.40c	1.40c	1.40c	1.25c	1.24c	1.20c	1.17c	1.11c	1.08c	1.12c
Bar iron	1.39c	1.36c	1.37c	1.35c	1.30c	1.27c	1.30c	1.30c	1.25c	1.24c	1.23c	1.25c
Sheets (28 gage black)	2.20c	2.20c	2.20c	2.17c	2.15c	2.00c	2.00c	1.94c	1.90c	1.85c	1.85c	1.89c
Sheets (28 gage galvanized)	3.20c	3.20c	3.20c	3.17c	3.15c	3.00c	3.00c	2.95c	2.91c	2.89c	2.85c	2.89c
Tin plate	$ 3.60	$ 3.67	$ 3.70	$ 3.70	$ 3.70	$ 3.70	$ 3.70	$ 3.68	$ 3.60	$ 3.50	$ 3.40	$ 3.40
Wire nails (jobbers)	1.71c	1.75c	1.79c	1.80c	1.76c	1.78c	1.70c	1.69c	1.65c	1.64c	1.54c	1.54c
Hoops	1.50c	1.49c	1.45c	1.45c	1.45c	1.43c	1.40c	1.40c	1.36c	1.35c	1.31c	1.30c
Heavy melting steel	$13.31	$14.34	$14.20	$12.93	$12.62	$12.90	$12.94	$13.20	$12.62	$12.00	$12.00	$12 25

any time during the year. A large portion of the tonnage booked was in the form of contracts for forward delivery, but mill orders and specifications entered on mill books for rolling in December and January were extremely heavy and at the close of the year every indication pointed to very large production during the first part of 1912. On account of the unsettled condition of the market, jobbers and consumers allowed their stocks to become very low.

The following shows price reductions, per ton, during the first 11 months of 1911: Bessemer pig iron, 75 cents; basic pig iron, $1.15; No. 2 foundry pig iron, 65 cents; gray forge iron, 50 cents; malleable iron, $1; Bessemer billets, $4; beams, $6; plates, $6; steel bars, $7; bar iron, $3; black sheets, No. 28 gage, $7; galvanized sheets, No. 28 gage, $7; tin plate, $2; wire nails, $4; hoops, $4; heavy melting steel, $1.50.

The following shows price reductions, per ton, from Jan. 1, 1910, to Dec. 1, 1911: Bessemer pig iron, $2.75; basic pig iron, $4.95; Bessemer billets, $9; steel bars, $9; tank plates, $9; beams, $9; black sheets, No. 28 gage, $13; galvanized sheets, No. 28 gage, $14; wire nails, $7; heavy melting steel, $5.75.

New Construction

New construction in the western Pennsylvania field during the year 1911 consisted almost entirely of the completion of new steel works planned and started in the two preceding years. The Jones & Laughlin Steel Co. completed its second unit of 12 tin mills, doubled the capacity of its wire mills and completed four open-hearth steel furnaces at Aliquippa, Pa., and rebuilt No. 3 stack of the Eliza group of blast furnaces. The Republic Iron & Steel Co. completed its No. 4 Hazelton blast furnace, eight 60-ton basic open-hearth furnaces, blooming mill, billet and sheet bar mill, 90-inch plate mill with a capacity of 5,000 tons a month, and merchant bar mill with a capacity of 10,000 tons a month. The Cambria Steel Co. completed and placed in service its new wire plant. The Youngstown Sheet & Tin Plate Co. started work on six 60-ton open-hearth furnaces, blooming mill, billet and sheet bar mill. The Pittsburgh Crucible Steel Co. purchased the blast furnace of the Midland Steel Co., at Midland, Pa., and started work on six open-hearth steel furnaces, blooming mill and billet mill. The Pittsburgh Steel Co. awarded contracts for two blast furnaces, four open-hearth steel furnaces and merchant mills to be built at Monessen, Pa., in 1912. The Follansbee Bros. Co. completed two new sheet mills and the McKeesport Tin Plate Co. completed two new tin mills at McKeesport, Pa.

Pig Iron

On account of the low prices prevailing at the beginning of the year, which some producers contended were near the cost line, the decline in the pig iron market in 1911 was not as great as during the preceding year, but prices sagged throughout the 12 months and on some grades sales were made at the lowest level in years. In only two months of 1910, the banner year, did the monthly production of merchant and non-merchant furnaces drop below the 2,000,000-ton mark, while only in three months of 1911—March, April and October—did the monthly production exceed that figure. Owing to the unsatisfactory condition of the market, some merchant stacks were inactive throughout the 12 months.

The Bessemer pig iron market did not attract a great deal of attention during the year and comparatively few important sales were made, the two largest involving 25,000 tons each. This market was established at $15, valley, at the beginning of the fourth quarter of 1910, and was quoted at that figure until early in October, 1911, when M. A. Hanna & Co. sold 1,000 tons to the Interstate Foundry Co., of Cleveland, at $14.65, valley, or $15.55, delivered, Cleveland. Prior to this time, the $15 price had frequently been shaded by middlemen on small tonnages, but this was the first lot running into four figures sold by a furnace at less than $15, valley. Within a week or so, the market dropped to $14.50, valley, and on Oct. 28, a local steel casting company bought 200 tons at $14.25, valley. On Nov. 14, the market dropped to $14, valley, by a sale of a small lot by a middleman. According to carefully compiled statistics, this was the lowest price level for Bessemer since July, 1905. About the middle of November, the Republic Iron & Steel Co. arranged a conversion deal with the Youngstown Iron & Steel Co., taking 25,000 tons of Bessemer in exchange for ore. In December, the Youngstown Sheet & Tube Co. bought 25,000 tons at $14.25, valley.

There was more activity in the basic market, but prices declined steadily throughout the year, the low point being reached early in December, when the Jones & Laughlin Steel Co. purchased between 30,000 and 40,000 tons from two sellers on a basis of $12.10, valley, this being the lowest price on record for basic iron. The year opened with basic quoted at $13.50, valley, or $14.40, Pittsburgh. Several sales were made on this basis in January. Numerous sales involving from 1,000 to 5,000 tons were made in February and prices stiffened, $13.75, valley, being the minimum during February, March and April. During the latter part of May prices weakened and the market dropped to $13.25, valley. There was a further decline in July. The purchase of 60,000 tons by the Republic Iron & Steel Co. from the Struthers Furnace Co., giving ore in exchange, and heavy sales by other furnace interests, gave the market a better tone and during the latter part of August prices were advanced slightly. From Sept. 1 until the middle of December, prices sagged, and during October iron was offered by most furnaces at $12.50, valley. About the middle of November, the American Steel Foundries purchased about 25,000 tons for its Alliance, O., and western plants at about $12.25, valley, and a month later the Jones & Laughlin Steel Co. closed for 30,000 to 40,000 tons at $12.10, valley. One of the developments of this market during the year was the sale of the Midland Furnace Co.'s stack, at Midland, Pa., to the Pittsburgh Crucible Steel Co. The contract whereby the Pittsburgh Steel Co. obtained its supply of basic iron from two valley furnace interests was cancelled during the year.

At the beginning of the year, No. 2 foundry iron was selling at $13.75, Pittsburgh, and during the latter part of March and early in April was sold at an advance of 25 cents a ton, dropping back to the $13.75, valley, mark late in April. There was a further drop of 25 cents a ton about the middle of June and early in November $13, valley, was reached.

The market on malleable iron at the beginning of the year was quoted at $12.75, valley. Gray forge was quoted at $13 on Jan. 1 and during the closing month of the year sales were made as low as $12.50, valley.

Semi-Finished Steel

In semi-finished steel, the year 1911 was a distinct disappointment. According to carefully compiled statistics, prices on crude steel reached the lowest level in several years. Production at certain periods during the year was fair and during the closing month most of the available capacity was in operation. The year 1910 closed with steel mills operating at

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Business Depression Keenly Felt in the East

During Year of Development of Momentous Issues—Principal Events of the Period—Some Encouraging Indications at Opening of 1912

By Chas J Stark

At the close of a year in the iron and steel industry, when final balances have been struck and retrospective judgment has sought to rank events according to their true scale of importance, it is often said that, within the period left behind, have fallen developments which promise to exert far-reaching influence upon the future movements of trade.

Seldom, however, has a period of 12 months been fraught with the rise to prominence of so many questions of deep significance and of movements affecting so directly not only the status of the iron and steel trade, but generally the fabric of the nation's entire commercial system as has the year of 1911.

These developments have come chiefly from the attitude of the general government in its determination strictly to enforce the provisions of the Sherman anti-trust law. It needs not to be said now that such vigorous resuscitation given to a so-called inactive and archaic law involving such regulation of business, has been disturbing. Ample evidence in various forms and from different directions has made this plain. It has not been so much the strict provisions of the statute, however, that have undermined the confidence of the business world as it has been the doubt and uncertainty surrounding the latitude of the measure. The long-expected decisions of the supreme court of the United States in the Standard Oil Co. and American Tobacco Co. cases rendered in May have only partially dispelled the feeling of uncertainty that has prevailed among business men.

Governmental Proceedings

Within the year has come the projection into the iron and steel industry of direct governmental interference, which culminated in the filing at Trenton, N. J., Oct. 27, of a bill in equity praying for the dissolution of the United States Steel Corporation. The instituting of this suit had been preceded by events of a kindred nature that left no doubt as to the close federal scrutiny being made into the iron and steel industry. In June the Stanley congressional committee, empowered by the house of representatives to inquire into the organization, management and operations of the largest steel producer, began its sittings. At the hearings of this committee which subsequently followed, considerable attention was directed to the charge that the Steel Corporation exercised an excessive control upon the Lake Superior ore deposits through its mineral holdings and the ownership of railroad lines between the mines and the head of the lakes. On Oct. 26, the day preceding the filing of the federal action, the directors of the Steel Corporation, at a special meeting in New York, exercised their right under the contract to give notice by Jan. 1, 1913, of their purpose to cancel, on Jan. 1, 1915, the Great Northern ore lease, and also to reduce the freight rates on the ore-carrying roads of the Steel Corporation to amounts not exceeding 60 cents a ton. On June 29, federal indictments were returned at New York against 83 manufacturers for engaging in pooling arrangements in the wire trade. Some leading steel wire makers were included. All the defendants received fines upon entering pleas of nollo contendere.

Trade conditions in the year have been noted for the regime of genuine open market conditions, of keenness of competition that forced the sharpest decline of finished steel prices since 1898, and of the disappearance of what has been known as the cooperative policy of steel makers, originally advocated by Judge Gary in 1907 and followed generally for several years past. The announcement of Chairman Topping, of the Republic Iron & Steel Co., on May 24, that thereafter his company would follow more aggressive selling policies, precipitated by degrees the most demoralized market the steel trade has

AVERAGE MONTHLY PRICES OF RAW AND FINISHED MATERIALS IN EAST DURING 1911.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Basic pig iron (eastern Pa.)	$14.50	$15.00	$15.25	$15.25	$14.75	$14.50	$14.50	$14.50	$14.50	$14.50	$14.25	$14.25
No. 2X foundry, Philadelphia	15.50	15.50	15.75	15.50	15.25	15.00	15.00	15.00	15.00	15.00	14.85	14.75
Low phosphorus, Philadelphia	21.50	21.00	21.00	21.00	21.00	20.50	20.50	20.50	20.50	20.25	19.50	19.25
Standard gray forge (eastern Pa.)	14.50	14.50	14.75	14.75	14.75	14.50	14.50	14.50	14.50	14.50	14.50	14.50
Open hearth billets, Philadelphia	25.40	25.40	25.40	25.40	25.40	24.40	24.40	23.40	23.40	21.40	21.40	21.40
No. 1 heavy steel (eastern Pa.)	12.75	14.25	14.25	13.75	13.25	13.00	13.00	13.25	12.75	12.00	12.25	12.50
No. 1 railroad wrought (eastern Pa.)	16.25	17.00	17.00	16.00	15.50	15.25	15.50	15.50	15.00	14.25	14.25	14.75
Heavy machinery cast (eastern Pa.)	14.25	14.25	14.25	13.75	13.25	13.25	13.25	13.25	13.25	12.75	12.75	13.00
Tank plates, Philadelphia	1.55c	1.55c	1.55c	1.55c	1.55c	1.50c	1.50c	1.45c	1.40c	1.30c	1.30c	1.35c
Structural shapes, Philadelphia	1.55c	1.55c	1.55c	1.55c	1.55c	1.50c	1.50c	1.45c	1.40c	1.30c	1.30c	1.35c
Steel bars, Philadelphia	1.55c	1.55c	1.55c	1.55c	1.55c	1.40c	1.35c	1.30c	1.30c	1.20c	1.25c	1.30c
Common iron bars, Philadelphia	1.30c	1.30c	1.35c	1.35c	1.30c	1.30c	1.30c	1.30c	1.25c	1.25c	1.25c	1.30c
Virginia No. 2 foundry	$12.75	$12.75	$13.00	$13.00	$13.00	$12.25	$12.25	$12.25	$12.25	$12.25	$12.25	$12.25

known in more than a decade. Prices reached bottom in October and November and under the impetus of a heavy buying movement, reacted toward higher levels. The conditions that now rule in the iron and steel industry give rise to the interesting speculation whether the former methods of co-operation and conciliation between steel makers will ever be fully resumed.

Eastern Finished Market

The east has reflected clearly the remarkable price decline and the lack of normal trade that have so marked the year. From no viewpoint can the period be surveyed with any feelings of great satisfaction by eastern steel makers. A number of the plants began the year of 1911 with operations of about 50 per cent of capacity and at the close this scale of output had not been greatly altered, although one or two more specialized plants, such as the Bethlehem Steel Co., were running above this rate. At times in the early part of the year, production expanded in conformity with a more active market and some of the plate mills reached as high as 70 per cent. These spurts did not last, however, and with the break of prices in May and the appearance of the keenest form of competition and of excessively low prices, the attitude of the buyer became one of assurance and that of the steelmaker, of caution. Under the condition of general business uncertainty that was apparent, the consumer was no more willing to discount the future and to replenish his exhausted stocks than the steelmaker was agreeable to the acceptance of forward commitments at profitless prices. The result was the paring of daily tonnage to pressing requirements and the lapsing of mill operations to a practically half-capacity activity. The appearance of the more favorable developments in the last quarter of the year left only marginal effect upon the eastern plants owing to the fact that the great portion of this tonnage was offered in districts where the former could not compete. The policies of eastern mills have uniformly been those of conservatism in aggressively seeking business at the ruling levels. Improvement in output was, therefore, coming very slowly to the east at the onset of the new year.

Finished prices in the east during the year crossed low marks not hitherto reached in many years. Plates and shapes sold on a basis of 1.10c, Pittsburgh, or 1.25c, Philadelphia district, and in some cases of preferred tonnage this figure was clipped. Steel bars at one stage dropped below 1.05c, Pittsburgh. Iron bars suffered from the unusual quotations on steel bars and the eastern mills ran on poor schedules. Common iron bar prices ranged in the year between the points of 1.20c to 1.30c, Philadelphia. Billets were lowest at $21.40, Philadelphia, for open-hearth material. Competition in tin plate and wire products, on occasions, brought out quotations entirely out of line with crude steel and finished costs.

Poor Pig Iron Year

Eastern merchant furnaces entered upon the year prudently and with caution. The steady decline of prices and demand during the preceding year had brought them to the beginning of 1911 with modified expectation of active operations and satisfactory profits during the months before them. Stocks had been reduced to a point that made the average tonnage per furnace probably less than for any other district in the country and obligations for high-priced raw materials had been liquidated to a minimum. The determination not to operate, except at some profit, ran strongly through the policies followed throughout the year. Plants were steadily shut down when no price improvement or clear prospects of better trade conditions appeared. It has frequently been said that the eastern merchant iron producers have handled their problem of over capacity and under demand with more vigor and dispatch than those of any other leading iron-producing center. The compliment is deserved, for the problems have not been easy ones. The curtailment effected is illustrated by the fact that at the beginning of 1912 production of merchant iron was down to less than 50 per cent of capacity in eastern and central Pennsylvania. In New Jersey not a single stack was blowing, the Wharton plant of four furnaces having remained cold the entire year. Production, at a low stage a year ago, was not materially increased even under the heavy bookings of November, which were by far the largest of the year, showing how rigidly the eastern Pennsylvania makers had committed themselves to their policy of not maintaining more than minimum operations under present conditions. A survey of furnace activities in these districts showed at the close of the year six merchant coke and anthracite furnaces blowing, and 11 out in the Lehigh valley, including two Bethlehem Steel Co. stacks, as this company is now a free seller of iron; six in and six out in the Schuylkill valley, with similar conditions of operations in the lower Susquehanna and the Juniata valleys.

The market for the eastern Pennsylvania merchant producer has apparently become considerably narrowed through the competition of other districts enjoying advantages in raw material costs and also through the fact that several of the eastern steel makers, formerly large buyers of basic, are now supplying their pig metal from furnaces which they own or control. By quoting down to $13, furnace, for No. 2X, and lower in some cases, Buffalo makers in the year have been able to overcome the practically 50 per cent freight disadvantage to New England points and to hold the great part of that territory against eastern Pennsylvania producers. Buffalo iron has also sold freely at tidewater at New York. It is such conditions in connection with a reduced local melt that have driven many eastern stacks to idleness and have made the outlook uncertain as to their resumption. The appearance of the Bethlehem Steel Co. as an avowed merchant seller of foundry and steel-making grades in October is another very important fact that has arisen to complicate the selling position of the eastern merchant furnaces. This steel company, with a largely increased furnace capacity, announces it is in a position to regularly offer 200,000 tons or more annually to the merchant trade based on its own present consumptive requirements. While it had previously sold some iron in the east, this had been done irregularly and spasmodically.

To continue in operation, it has been necessary for the eastern furnacemen to accept lean profits or none at all. Competition has been keen and buyers, appreciating their advantages, have remained quite indifferent with some exception toward the close of the year. Prices have been freely shaded where necessary, though the danger line of costs has usually, but not always, fixed the minimum point of these concessions. On No. 2X foundry, the lowest points reached in the year have been approximately $13, central Pennsylvania; $13.50, Lebanon valley, and $13.75, Lehigh and Schuylkill valley furnaces, though such levels were usually offered in the more distant markets. In the Philadelphia market, the fluctuation on No. 2X foundry iron over the year is included in the range of $14.75 to $15.50, delivered.

Basic iron reached an exceptionally low figure in the east at $14.25, delivered, or about $13.50, furnace, op-

(Continued on page 124.)

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THE AVERAGE PAID CIRCULATION OF THE IRON TRADE REVIEW FOR THE ISSUES OF THE FOLLOWING MONTHS WAS:

January, 1911	6,058
February	6,072
March	6,091
April	6,108
May	6,112
June	6,124
July	6,138
August	6,152
September	6,161
October	6,172
November	6,186
December	6,206

January 4, 1912.

Bright Prospects Follow Disappointments

In our issue of Jan. 5, 1911, the year 1910 was referred to as a record year for tonnage and disappointments. The year which has just closed has not been record making in tonnage, but it has indeed been heavy in disappointments. The only satisfactory part of 1911 was the last few weeks, and it closed with extremely bright prospects and with a definite hope that it would prove the fallacy of the popular notion that presidential years are necessarily periods of depression.

At the opening of the year 1909, there was a general feeling of confidence in the trade that normal activities would be restored during the twelve months, and this expectation was to a large extent realized, although improvement was by no means unbroken, for tariff revision and the break in prices which all but wrecked the price maintenance movement were important features of the year. Then came 1910 with its heavy production, its declining prices throughout the year, and its political uncertainty. At the opening of 1911, there seemed reason for believing that the three chief causes of the depression in 1910—the political conditions, the railroad rate controversy, and the overdoing of the partial recovery in 1909—would not operate to cause further trouble during the new year. This hope as to politics has not been realized, and, as to the railroads, improvement did not set in until the eleventh month of the year. Reduction in prices continued until almost the close of the year and the decline of some leading products in two years, from Jan. 1, 1910, to Jan. 1, 1912, has been as follows:

	Jan. 1, 1910.	Jan. 1, 1912.	Decline.
Bessemer pig iron	$19.90	$15.15	$ 4.75
Basic pig iron	17.90	13.45	4.45
Bessemer billets	27.87	20.00	7.87
Steel bars	29.80	24.00	5.80
Tank plates	31.00	24.00	7.00
Beams	31.00	24.00	7.00
Black sheets	48.00	38.00	10.00
Galvanized sheets	70.00	58.00	12.00
Wire nails	37.00	31.00	6.00
Heavy steel	17.56	12.25	5.31

The full details of the events of the year are told in our annual reviews published elsewhere in this issue. At last, a turn for the better has come and much more favorable conditions prevail now than were hoped for even a few weeks ago. While it is interesting to discuss causes for industrial troubles and the probable course of future events, and although there are still some dark clouds in the political skies, this great country of ours has a way of disregarding politics and other considerations when it gets ready to do business. Hence, there is abundant reason for feeling cheerful as the new year opens.

Record Exports in 1911

A quarter billion dollars was approximately the value of iron and steel exports in 1911, this being 18 per cent in excess of the value in 1910, the previous record year, and 27 per cent in excess of the value in 1907, which year had formerly held the record.

About 30 per cent of the total value of iron and steel exports in 1911 was represented by the tonnage lines, scrap, pig iron, rolled iron and steel, wire products, pipe, etc., the weight of which is returned in the official statistics. The tonnage thus involved, 187,543 gross tons for November, and 1,996,639 tons for the 11 months ending November, promising a total for the calendar year of about 2,185,000 gross tons, this being 42 per cent in excess of the tonnage in 1910, which held the record, and 65 per cent in excess of the tonnage in 1906, which previously held the record. The record tonnage prior to 1910 was in 1906, but the record value was in 1907.

While the increase in the tonnage lines of 42 per cent from one year to the next was spectacular, the showing is made still more impressive by considering that from 1910 to 1911 our pig iron production decreased about 13 per cent, the 1910 production having been 27,303,567 tons, while a week ago we estimated the 1911 production at 23,650,000 tons. In 1910 the weight of exports was 5.6 per cent of the pig iron production, while in 1911 the production rose to 9.2 per cent.

Agricultural implements which are not included in the government summary of iron and steel exports, were shipped abroad to the extent of $35,000,000 in 1911, showing a gain of 12 per cent over 1910 and of 110 per cent over 1901, a decade ago.

The value of iron and steel exports in November was $21,547,399, and in the 11 months ending November, $227,469,893, presaging a total for the year of about $250,000,000, making the following comparison with preceding years:

1898	$ 82,771,550
1899	105,689,077
1900	129,633,480
1901	102,534,575
1902	97,892,036
1903	99,035,865
1904	128,553,613
1905	142,928,513
1906	172,555,588
1907	197,066,781
1908	151,113,114
1909	157,674,394
1910	201,271,903
1911	250,000,000

The tonnage exports compare as follows:

	Gross tons.
1898	901,427
1899	942,689
1900	1,154,284
1901	700,857

1902	372,398
1903	326,590
1904	1,167,710
1905	1,010,255
1906	1,325,740
1907	1,301,979
1908	964,242
1909	1,243,467
1910	1,537,952
1911	1,185,000

Our Annual Chart

The two charts which are printed on one sheet as a supplement to this issue show fluctuations in prices of leading iron and steel products for the last 17 years. The figures on which the charts are based are the average weekly prices given in the market reports of THE IRON TRADE REVIEW. They are computed for the following: Tank plates, Chicago; beams, Pittsburgh; bar iron, Cleveland; Bessemer billets, Pittsburgh; Bessemer pig iron, Pittsburgh; No. 2 foundry, Chicago; gray forge, Cincinnati; No. 2 foundry, Birmingham; steel bars, Pittsburgh.

The vertical lines in the chart for 16 years represent months and weeks in the chart for 1911, and the horizontal lines the prices in dollars per net ton in the case of finished material, and per gross ton in the case of pig iron and steel billets. The solid and broken lines traversing the diagram indicate the change in the average prices, but do not, of course, show the extreme high or extreme low prices which may have been reached in some days of the month or week. In the case of pig iron, the minimum quotations for prompt delivery are taken. For finished materials, the prices are for prompt delivery or carload lots.

The upper chart shows the very short-lived boom in 1895, which followed the period of depression; then the decline in the latter part of 1895 followed by the slow general decline of 1896 and 1897, when in mid-summer the lowest prices on record prevailed; the rather steady trend of prices from the middle of 1897 to the fall of 1898; the rapid rise at the close of 1898 followed by the very high quotations of the boom year 1899; the sharp decline beginning in September, 1899, and continuing until the midsummer of 1900; a partial recovery at the close of 1900, and the continuance of prices upward during 1901; the rapid advance during the first half of 1902 and sharp decline beginning in the fall of 1902 and continuing during 1903, followed by a long period of prosperity with occasional recessions, ending suddenly in October, 1907.

Owing to the price maintenance policy which prevailed throughout the year 1908, prices were much more regular than they would have been without it, but with the declaration of the open market in 1909, the chart shows a dip in the lines, and a gradual recovery from the middle of the year. But the high prices attained in other years of prosperity were not reached in 1909, and the year closed with prices on a number of products about the same as they were at the beginning of the year. The downward trend started in February, 1910, and continued throughout the year, but pig iron prices have shown considerable steadiness for several months, owing to the very low quotations which were made in August and September.

For the year 1911, a new form of chart is issued, showing the fluctuations by weeks. The decline was not as continuous as in 1910, but in finished products started sharply in the week beginning May 24. Important recessions are shown in other months, especially in September, October and November, the upward turn coming in December. The pig iron market for 1911 shows a decline, but not to so great an extent as that of the preceding year. For a few days only, southern No. 2 dropped below $10 for the first time since 1904.

A few extra copies of the chart have been printed and will be furnished in tubes for framing. The charts will fit into the frames used for past years.

The board of engineers of the state of California is about to ask for bids on a reinforced concrete arsenal and armory to be erected at San Francisco, at a cost of $100,000. A large amount of bars and steel trimmings will be included in the specifications.

LARGE COKE TONNAGE

Shipped by J. K. Dimmick & Co. to Crow's Nest Pass, a Distance of 2,500 Miles.

One of the features of the year just closed was the shipment of an immense tonnage of Connellsville coke from the Pennsylvania fields to Crow's Nest Pass, District of British Columbia and Alberta, by J. K. Dimmick & Co., of Philadelphia, Cleveland and Uniontown, Pa. This unusual large transfer for such a long distance was brought about because of a strike among the coal miners of the Crow's Nest Pass territory, from last April to October, thereby causing a serious shortage of coke among the western Canadian smelters. An agent of the Dimmick company, therefore, took advantage of the situation, visited that district and promptly secured orders to supply all the tonnage required by these smelters. The coke was all loaded at Lorain, O., in vessels of 10,000 capacity, the loading being handled entirely by the Cleveland office. The coke shipped by lake amounted to approximately 100,000 tons, and 10 cars per day were shipped by rail during the summer. It took the railroad equipment over two months to be delivered back to its home roads. The shipment consisted of consignments to Lorain, O., by rail, then by vessel across the lake to Fort William, Ont., and Superior, Wis., and then by the Canadian Pacific to its destination. By shipping by water, there was a saving of $1.50 per ton, although it is questionable if this was profitable, because of the breakage in the extra handling. The all-rail freight rate from the Pennsylvania fields was about $9.25 per ton, and when shipped in this manner, the coke cost the smelters between $10 and $11 per ton, delivered. The distance of shipment was about 2,500 miles, and the freight alone amounted to over $1,000,000. The smelters in the Crow's Nest Pass are used mostly for the smelting of copper and lead, and some gold and silver.

Spanish Ore Advances

Commenting on the advance in the price of Spanish iron ore, the Middlesbrough correspondent of *The Ironmonger* says: "In rubio ore one or two small lots have recently been sold at 21s, but 21s 6d is now the minimum quoted by the merchants for delivery over the first few months of next year, and there is not much on offer, some dealers holdng for 22s. This compares with 19s 6d ruling two months ago, during which time hematite iron has advanced 4s 6d."

Pig Iron Output for 1911 Fell Far Below 1910

Both Merchant and Steel Works Stacks Produced Less Than the Previous Year

The total output of coke and anthracite pig iron for 1911 was 23,198,910 tons. This compares with 26,845,904 tons in 1910, showing a loss in output in 1911 of 3,646,994 tons; and with 25,322,483 tons in 1909, showing a loss in this comparison of 2,123,573 tons. The daily average production for the year 1911 was 63,558 tons, compared with 73,550 tons in 1910 and 69,376 tons in 1909.

AVERAGE DAILY PRODUCTION.

	1911.	1910.
January	56,989	83,871
February	63,617	86,769
March	69,863	83,508
April	68,163	82,590
May	60,367	76,607
June	59,109	76,276
July	57,294	69,617
August	61,995	67,864
September	65,797	68,282
October	67,486	67,297
November	66,637	63,680
December	65,568	57,416

The kindly co-operation of blast furnace managers throughout the country has made possible this presentation of the facts of pig iron production in 1911 at this early day, aiding in gathering the figures by the medium of the telegraph, telephone and by mail. The December production was 2,032,610 tons, compared with 1,999,100 tons in November, an increase of 33,510 tons. The merchant output was 562,565 tons, a loss of 12,737 tons compared with November. The non-merchant, or steel-plant production was 1,444,925 tons in December, an increase of 40,806 tons over November when the non-merchant output was 1,404,119 tons. The number of stacks active on the last day of December was 216, compared with 214 in November and the same number in October. The output of spiegel in December was 7,804 tons, compared with 13,993 tons in November. The production of ferro in December was 16,316 tons, compared with 5,686 tons in November.

As between the two halves of the year 1911 the output was fairly evenly divided. The production in the first half was 11,403,281 tons, compared with 14,759,037 tons in the first half of 1910. The output in the second half of 1911 was 11,795,629 tons, compared with 12,086,867 tons in the like period of 1910. The merchant furnaces produced 3,402,061 tons in the first half of 1911, and 3,007,185 tons in the second half. This compares with 1910, when in the first half merchant production was 4,807,644 tons, and in the second half 3,950,281 tons. In 1911 the non-merchant, or steel works, furnaces produced in the first half 7,898,507 tons, and in the second half 8,653,945 tons. In 1910 the non-merchant stacks produced 9,779,985 tons in the first half, and 8,017,370 tons in the second half. In neither of the halves of 1911 did the merchant furnace output equal that of 1910; but the non-merchant furnaces in the second half of 1911 surpassed the output of steel-making iron in the last half of 1910 by 636,575 tons.

The year 1910 ended with 196 stacks active on the last day of December; 1911 ends with 216 stacks active. The output of ferro in 1911 was 125,739 tons. The spiegel production was 110,473 tons.

MONTHLY PRODUCTION.

	1911.	1910.	1909.
January	1,766,658	2,599,995	1,787,473
February	1,781,285	2,429,525	1,682,470
March	2,165,764	2,583,736	1,822,024
April	2,044,904	2,477,700	1,731,406
May	1,871,388	2,374,802	1,866,757
June	1,773,282	2,288,279	1,929,929
July	1,776,108	2,158,124	2,088,620
August	1,921,832	2,103,793	2,232,642
September	1,973,918	2,048,461	2,376,039
October	2,092,061	2,086,205	2,589,681
November	1,999,100	1,910,385	2,532,740
December	2,032,610	1,779,899	2,682,702
Total	23,198,910	26,845,904	25,322,483

Hutchings Made Treasurer of Lake Superior Co.

F. W. Hutchings, secretary of the National Founders' Association since 1902, has been chosen treasurer of the Lake Superior Iron & Chemical Co., succeeding Alex Van Oss, who has been treasurer since the company's organization and now retires to enter other business lines. Before becoming associated with the National Founders' Association at Detroit, Mr. Hutchings was connected with the government service at Washington. At the annual meeting of the Lake Superior company, at New York, Dec. 29, these officers were reelected: President, John Joyce, Boston; vice president and general manager, W. H. Matthews, Detroit; secretary, L. F. Knowles, Detroit; directors, John Joyce, W. H. Matthews, H. H. Melville, Boston; Geo. H. Russell and F. W. Blair, Detroit; E. M. Harrison and Alvin Untermeyer, New York; Thomas McDougall, Quebec; W. G. Sharp, Elyria, O.; W. A. Charlton, Toronto, and M. Cochrane Harmon, Chicago.

Mr. Hutchings will sever his connection with the National Founders' Association as soon as arrangements can be made.

DECEMBER PIG IRON.

States.	No. of stacks.	No. in blast last day of month.		Total tonnage made.		——Totals.——	
		Dec.	Nov.	Merchant.	Non-Merchant.	Dec.	Nov.
Pennsylvania	158	88	86	161,169	684,209	845,378	819,906
Ohio	72	44	39	119,807	328,189	447,996	441,603
Alabama	45	20	20	117,395	42,549	159,944	156,436
Virginia	24	7	7	22,757	.....	22,757	23,683
New York	27	13	13	52,766	71,523	124,289	119,461
New Jersey	7	..	..	.....	.....	.....	.....
Illinois	24	15	17	22,827	168,155	190,982	197,977
Colorado	6	3	4				
Indiana	9	6	7				
Maryland	4	3	3				
Wisconsin	6	3	3	19,922	123,974	143,896	143,381
Kentucky	7	1	2				
West Virginia	4	3	3				
Tennessee	18	7	7				
Washington	1	..	..	34,776	27,326	62,102	63,869
Georgia	2	..	..				
Texas	3	..	..				
Minnesota	1	1	1				
Michigan	3	2	2				
Missouri	1	..	..	11,146	.....	11,146	13,105
Spiegel—All states						7,804	13,993
Ferro—All states..						16,316	5,686
Totals	422	216	214	562,565	1,444,925	2,032,610	1,999,100

Copper exports for December were very heavy, totaling 37,430 tons. Total copper exports for 1911 were 336,506 tons, compared with 301,935 tons in 1910.

BILLETS ADVANCE

Forging Billets Go to $28.00—Other Semi-Finished Steel Firm.

Pittsburgh, Jan. 2. (By wire.)—The leading interest has advanced the price of forging billets to $28, Pittsburgh. This represents an advance of $3 a ton in the past three weeks. A few smaller mills are not as yet filled up and $26 can still be done on desirable tonnages. The market is quotable at $26 to $28.

Prices of both rolling billets and sheet bars are also firmer at $20 for Bessemer and open-hearth rolling billets, while $21 for Bessemer and open-hearth sheet bars, Pittsburgh or Youngstown, is now the absolute minimum. Some mills are booked solidly for the next 30 to 60 days.

Death of H. T. Chandler

Harrison T. Chandler, president of the firm of Chandler & Price Co., Cleveland, manufacturer of printing machinery, died at his residence, 10007 Euclid avenue, that city, on Jan. 1. Mr. Chandler was born in Chandlerville, Ill., in 1840. He served as the head of a bank in that place for ten years, and came to Cleveland in 1881, where he bought an interest in the Cleveland Type Foundry, serving as one of its officers for three years. He then formed the partnership of Chandler & Price, which company was incorporated in 1895, Mr. Chandler being chosen as president, and which position he held to the time of his death.

Allis-Chalmers Affairs

Allis-Chalmers Co. directors have decided that in view of conditions affecting their business it would not be advisable to pay the interest on the first mortgage bonds, due Jan. 1. It is not unlikely that receivership proceedings may be commenced. It is now stated that Judge E. H. Gary resigned several months ago as chairman of the Allis-Chalmers board. He has been succeeded by E. D. Adams, representing the Deutsche Bank of Berlin.

Low Prices Made on Boiler Tubes

Very low prices have been made on boiler tubes, and contracts are being made at the following discounts: 3½ and 4-inch, 77½ per cent; 3-inch, 75 per cent; 2¾ and 3¼-inch, 72½ per cent; 2½-inch, 70 per cent; 1¾ and 2¼-inch, 67½ per cent. These prices represent reductions of about $5 per ton. For contracts up to April 1, the 5 and 5 per cent off heretofore granted, are made in addition, but on contracts from April to July only 5 per cent is allowed.

Talk Merger

Pittsburgh, Jan. 2 (By wire.)—Representatives of the Phillips Sheet & Tin Plate Co. and of the Pope Tin Plate Co. refuse officially either to affirm or deny the report sent out from Steubenville, O., to the effect that the former concern has closed negotiations for taking over the Pope company. It is believed here that the report is premature, but it is understood that negotiations are pending.

George S. Patterson, who has been prominently connected with the automobile business in Cleveland for a number of years, started Tuesday night for San Francisco, where he will have his headquarters as western representative of the Marquette Motor Co., of Saginaw, Mich. His address for the present will be Palace Hotel.

Pig Iron Prices

PITTSBURGH.

(Prompt Shipment.)

Bessemer, valley	$14.25
Bessemer, Pittsburgh	15.15
Basic, valley	12.35
Basic, Pittsburgh	13.25
No. 2 foundry, Pittsburgh	13.90
Gray forge, Pittsburgh	13.65
Malleable, Pittsburgh	13.65

(First Quarter.)

Bessemer, valley	$14.25
Bessemer, Pittsburgh	15.15
Basic, valley	12.35
Basic, Pittsburgh	13.25
No. 2 foundry, Pittsburgh	13.90
Gray forge, Pittsburgh	13.65
Malleable, Pittsburgh	13.65

CHICAGO.

(First Half Shipment.)

Lake Superior charcoal	$16.50
Northern foundry No. 2	14.00
Southern foundry No. 2	14.35
Southern silveries, 5 per cent silicon	15.60
Jackson Co. silveries, 8 per cent	17.40
Malleable Bessemer	14.00
Alabama basic	14.35

CLEVELAND.

No. 1 foundry	$13.75
No. 2 foundry	13.25
No. 2 southern	14.35
Gray forge	12.50
Bessemer	15.15
Lake Superior charcoal	16.50
Jackson Co. 8 per cent silvery	17.05

CINCINNATI.

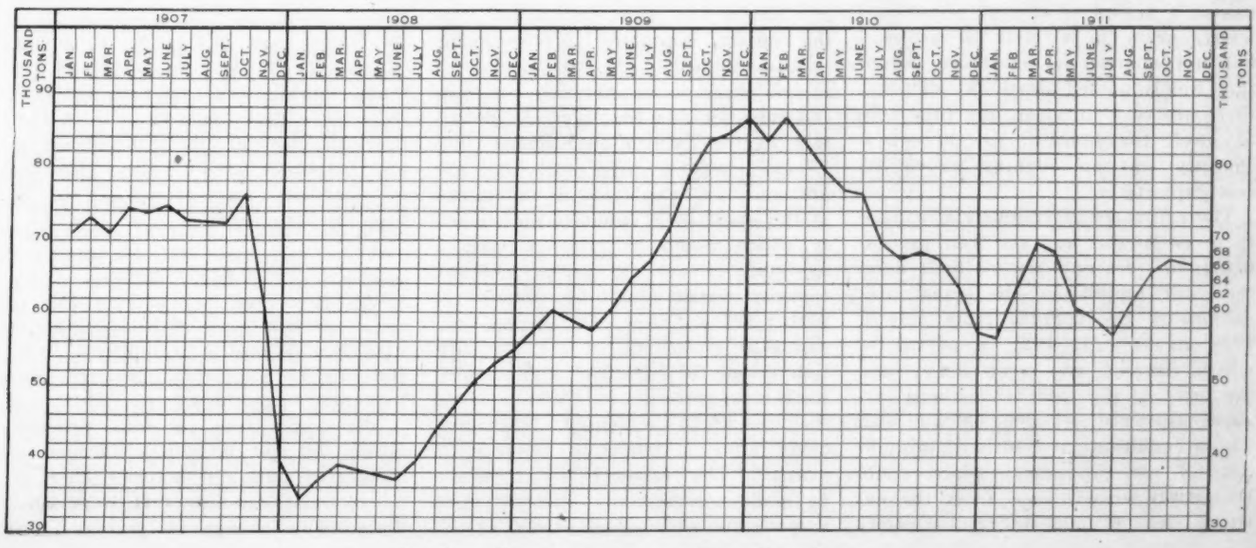
Southern foundry No. 2	$13.25
Southern foundry No. 3	13.00
Southern foundry No. 4	12.75
Southern gray forge	12.50
Mottled	12.50
Southern No. 1 soft	15.20
Southern No. 2 soft	14.70
Standard southern car wheel	25.50
Northern No. 2 foundry	14.20
Northern No. 3 foundry	13.70
Northern No. 4 foundry	13.20
Jackson county 8 per cent silicon	16.95

PHILADELPHIA.

No. 1X foundry	$15.25 to 15.50
No. 2X foundry	14.75 to 15.25
No. 2 plain	14.50 to 14.75
Standard gray forge	14.25 to 14.50
Basic	14.25 to 14.50
No. 2X Virginia	15.05 to 15.30
No. 2 southern	14.00 to 15.00
Standard low phosphorus	19.50 to 20.00

NEW YORK.

Northern foundry No. 1	$14.75 to 15.00
No. 2X foundry	14.50 to 14.70
No. 2 plain	14.25 to 14.50
No. 2 Virginia	15.05 to 15.30
No. 2 southern foundry	14.50 to 15.00
Malleable	15.00 to 15.25
Gray forge	14.25 to 14.50



Pig Iron Production of the Past Five Years.

Only Four New Blast Furnaces Added Last Year

Compared With Thirteen New Stacks in 1910--United States Steel Corporation Building at a Decreased Rate—New Plants Proposed

By B E V Luty

The actual capacity of the blast furnaces of the United States on Jan. 1, 1912, is about 33,400,000 tons per annum.

As was remarked a year ago, the object of these annual reviews of blast furnace construction is to give the trade the information it most needs with respect to blast furnace capacity. Obviously it is the commercial capacity, the actual ability of the furnaces as a whole to make a specific number of tons of pig iron in a year, and not the nominal or theoretical capacity, which is of chief interest to the trade. The summaries sometimes published, compiled by adding together all the rated capacities reported on behalf of all the furnaces physically in existence, have their uses, but such summaries are sometimes taken up in trade quarters where they cannot be interpreted properly, and information useful in its way is thus misapplied. Apart from the fact that furnace capacities are frequently, if not usually, overrated by their managers and the further fact that no individual estimate is going to allow for accidents or relining, although among all the furnaces there must always be a percentage out for relining or repairs, there is a distinction between physical existence and commercial existence. Hundreds and hundreds of blast furnaces have been abandoned and dismantled in the history of the iron trade, but the great majority of them passed a period of several, sometimes many, years in a state of physical but not commercial existence before they finally passed away. At all times there are such furnaces, and they help to swell the nominal or theoretical capacity of the country above its real capacity.

The estimates of commercial capacity given in this and the four preceding annual reviews are all built upon the same foundation, the actual production of the country from July 1, 1906, to July 1, 1907, a period in which demand was very heavy and the price of pig iron at northern furnaces averaged between $20 and $22. Those conditions, it is insisted, brought out all the production which could reasonably be expected from the existing furnaces, and the total capacity at various dates since then is regarded as being this basis capacity plus the capacity of new furnaces since completed. Some furnaces are abandoned, others are rebuilt or otherwise improved, and such changes affect the total. We have been assuming that such changes balance each other and that the increase in capacity is neither more nor less than the contribution of the absolutely new furnaces built. It is unfortunate in more ways than one that a period has not arrived in which the capacity of the furnaces would be shown by actual experience, for it is now more than four years since the furnaces ran full.

In these four years, there has been much work done by way of rebuilding and improving blast furnaces, and the year 1911 furnished its full quota of such work. Furthermore, progress is still being made in the art of running blast furnaces, and this is a point of considerable importance. An increase of only 3 per cent in the output of all existing furnaces would mean 1,000,000 tons a year. Thus it is possible that estimates based upon the performance of four years ago, with allowance for the new furnaces completed since, are somewhat too low.

On the other hand, it must be observed that lately there has been an open market in pig iron and steel products, and the capacity capable of operating at a profit or even of avoiding a loss is much smaller than the capacity determined by the means just mentioned. At each level of prices, there is an effective commercial capacity, and the basis of production in the twelvemonth ended July 1, 1907, was a high one. At the present time, the trade is interested in the question of what is the capacity which would be effective upon a moderate advance in prices, not the capacity which would be effective at $20 or $22 pig iron. It requires considerable stretching of the imagination even to consider such prices. Rather the question is: "Where would the check of increased production come after a moderate advance in prices?" The capacity which would be made commercially effective upon a moderate advance in prices, say $1 to $3 a ton, is the capacity which is now of interest.

How Capacity is Computed

Taking the production in the twelvemonth ended June 30, 1907, when northern pig iron averaged between $20 and $22 at furnace, 26,202,985 tons, and making allowance for the new furnaces which contributed only part of their annual output to that period, a basis is found, and the capacity of new furnaces completed in each succeeding year is added. Repeating the figures given a year ago and adding the 1911 contribution, we have:

	New in year.	Total at close.
Jan. 1, 1907....		25,960,000
1907.....	2,065,000	28,025,000
1908.....	1,188,000	29,213,000
1909.....	1,930,000	31,143,000
1910.....	1,794,000	32,837,000
1911.....	565,000	33,402,000

To this it may be added that ten furnaces now under construction involve a capacity of 1,385,000 tons, making the prospective capacity 34,787,000 tons. The mentioning of the odd figures should not be taken as promising exactness. It would be injudicious to drop into round figures because each year the problem is taken up where it was left off a year earlier, and to drop into round figures would be to introduce avoidable errors. The prospective capacity is about 35,000,000 tons. How high pig iron would have to go to make such capacity effective could not be stated. Raw material would have to be found, and pig iron advancing rapidly in the face of increased demand, might mean that raw materials were particularly hard to get. In that case, the fact of pig iron advancing fast would be an indication that the full capacity was not going to be brought into service.

The New Furnaces

The summary of new furnaces in existence a year ago included three furnaces as completed, although they had not been blown in. This was a departure from previous practice, which did not include a furnace as completed unless it actually blew in. Commercial conditions had changed, dictating a change in practice. The

three furnaces were Bethlehem F, Bethlehem G and Aliquippa No. 4. Two of these were blown in during 1911, Bethlehem F March 16, 1911, and Bethlehem G on July 29, 1911.

In 1911, two furnaces were practically completed, but not blown in, and are counted in the crop of 1911 furnaces. These are River No. 2, Cleveland, and Josephine No. 2 at Josephine, Pa., both controlled by Corrigan, McKinney & Co. Two other furnaces were completed in the year and blown in, Haselton No. 4 of the Republic Iron & Steel Co., in the Youngstown district, June 8, 1911, and Central D, Cleveland, of the American Steel & Wire Co., July 17, 1911.

The complete schedule of absolutely new furnaces completed in each of the past seven years is given in tabular form.

Furnaces Being Built

A year ago, a list was given of 13 furnaces being built. The four furnaces completed in 1911 leave nine of these which are still under construction. Indeed, one of the projects, involving two furnaces, only advanced to the stage of letting the contracts towards the close of 1911. While a number of furnace projects have been broached, we add to the list of nine only one as actually under construction, that being Madeline No. 2 of the Inland Steel Co., Indiana Harbor, Ind.

The ten furnaces are as follows:

Worth No. 2, Coatesville, Pa.	150,000
Inland No. 2, Indiana Harbor, Ind.	125,000
Two Iroquois, Chicago	280,000
Two Rogers-Brown, Buffalo	250,000
Two Minnesota Steel, Duluth	300,000
Two Pittsburgh Steel	280,000
Ten furnaces	1,385,000

The furnaces of the Worth Brothers Co. and the Inland Steel Co. will probably blow in within the first month or two of the new year. The Duluth furnaces of the United States Steel Corporation will not be blown in for a considerable time, as they must await the completion of an entire steel plant. It is to be noted that the Steel Corporation is building only two furnaces, and completed only one in 1911 and two in 1910, which may be taken as at the rate of one furnace per year, since it is quite improbable that in the next two or three years it will do more than complete the two Duluth furnaces. On the other hand, of 56 new furnaces in the five preceding years, the Steel Corporation furnished no less than 22, at the rate of more than four per year.

NEW FURNACES COMPLETED—1905-1911.

Date blown in.	Name of furnace.	Location.	Size.	Annual capacity.
1905.				
Jan. 1	Pine Lake (Chl.)†	Boyne City, Mich.	60 x 10½	29,000
Jan. 3	Donora No. 1*	Donora, Pa.	85 x 22	150,000
Jan. 21	Lackawanna No. 4	Buffalo	94 x 24	180,000
Feb. 7	Donora No. 2*	Donora, Pa.	85 x 22	150,000
Feb. 22	Lorain D*	Lorain, O.	85 x 22	150,000
Apr. 28	Ensley No. 6*	Ensley, Ala.	87 x 27¾	100,000
June 23	Woodward No. 3†	Woodward, Ala.	85 x 20	90,000
July 5	Buffalo-Susq. No. 2†	Buffalo	80 x 20	113,000
Sept. 3	Lackawanna No. 5	Buffalo	94 x 24	180,000
Dec. 28	Monongahela C*	McKeesport, Pa.	90 x 22	150,000
	Total in 1905, 10 furnaces			1,292,000
1906.				
Jan. 17	Cambria No. 7	Johnstown, Pa.	85 x 22	150,000
Jan. 21	Mingo No. 4*	Mingo Junction, O.	90 x 21½	145,000
Mar. 6	Cadillac (Chl.)†	Cadillac, Mich.	60 x 12	40,000
May 1	Lackawanna No. 6	Buffalo	94 x 24	180,000
June 21	South Works E*	South Chicago, Ill.	90 x 22	160,000
Sept. 3	Joliet No. 4*	Joliet, Ill.	90 x 22	150,000
Sept. 3	Palmerton No. 2†	Palmerton, Pa.	70 x 14	20,000
Sept. 6	Midland†	Midland, Pa.	85 x 21	150,000
Oct. 3	Haselton No. 2	Youngstown, O.	85 x 19½	140,000
	Total in 1906, 9 furnaces			1,135,000
1907.				
Jan. 1	Haselton No. 3	Youngstown, O.	85 x 20½	150,000
Jan. 5	Toledo No. 2†	Toledo, O.	80 x 20	135,000
Jan. 14	Josephine†	Josephine, Pa.	80 x 20	140,000
Feb. 1	Federal No. 1†	South Chicago, Ill.	75 x 18½	110,000
Feb. 12	Lackawanna No. 7	Buffalo	85 x 22	180,000
Apr. 22	Bethlehem E	South Bethlehem, Pa.	90 x 22	140,000
May 2	Mayville B†	Mayville, Wis.	77 x 17	90,000
May 2	Minnequa F	Pueblo, Colo.	85 x 20	125,000
June 4	Carrie No. 6*	Rankin, Pa.	85 x 22	160,000
June 16	Perry†	Erie, Pa.	75 x 17	100,000
Aug. 3	Carrie No. 7*	Rankin, Pa.	85 x 22	160,000
Aug. 7	Cambria No. 8	Johnstown, Pa.	85 x 21	150,000
Aug. 30	Madeline	Indiana Harbor, Ind.	85 x 19½	125,000
Sep. 26	Lorain E*	Lorain, O.	90 x 22	150,000
Oct. 10	Monongahela D*	McKeesport, Pa.	90 x 23	150,000
	Total in 1907, 15 furnaces			2,065,000
1908.				
Apr. 30	Vanderbilt No. 2†	Boyles, Ala.	80 x 18	80,000
June 30	Harvester No. 3	South Chicago, Ill.	90 x 21	140,000
Aug. 22	Miami†	Hamilton, O.	80 x 18	100,000
Oct. 4	Jisco (Silicon)†	Jackson, O.	75 x 17	28,000
Oct. 16	Wickwire X	Buffalo	80 x 20½	100,000
Nov. 2	Tube A	Youngstown, O.	88 x 22	180,000
Nov. 21	Ironton†	Ironton, O.	75 x 18	80,000
Nov. 23	Tube B	Youngstown, O.	88 x 22	180,000
Dec. 21	Gary No. 10*	Gary, Ind.	88 x 21½	150,000
Dec. 28	Gary No. 11*	Gary, Ind.	88 x 21½	150,000
	Total in 1908, 10 furnaces			1,188,000
1909.				
Jan. 15	Gary No. 12*	Gary, Ind.	88 x 21½	150,000
Feb. 11	Ohio No. 5*	Youngstown, O.	95 x 23	182,500
Mar. 17	Duquesne No. 5*	Duquesne, Pa.	95 x 22	182,500
June 13	Gary No. 9*	Gary, Ind.	88 x 21½	150,000
June 29	Ohio No. 6*	Youngstown, O.	95 x 23	150,000
July 14	N. Y. State	Buffalo	85 x 21	150,000
July 15	Federal B†	South Chicago, Ill.	80 x 20	125,000
Aug. 11	Duquesne No. 6*	Duquesne, Pa.	95 x 22	182,500
Sep. 20	Cleveland No. 2†	Cleveland	90 x 22	150,000
Nov. 20	Gary No. 8*	Gary, Ind.	88 x 21½	150,000
Dec. 1	Aliquippa No. 1	Woodlawn, Pa.	90 x 22	175,000
Dec. 4	Gary No. 7*	Gary, Ind.	88 x 21½	150,000
	Total in 1909, 12 furnaces			1,930,000
1910.				
Jan. 17	E. Jordan (Chl.)†	East Jordan, Mich.	60 x 10	24,000
Feb. 14	Aliquippa No. 2	Woodlawn, Pa.	90 x 22	175,000
Mar. 16	Gary No. 6*	Gary, Ind.	88 x 21½	150,000
Apr. 12	Aliquippa No. 3	Woodlawn, Pa.	90 x 22	175,000
May 10	Worth No. 1	Coatesville, Pa.	85 x 18½	120,000
———	Gary No. 5*	Gary, Ind.	88 x 21½	150,000
May 28	River No. 1†	Cleveland	83 x 20¼	125,000
July 20	Zug No. 2†	Detroit, Mich.	80 x 18½	100,000
Aug. 16	Tube C	Youngstown, O.	88 x 22	180,000
Oct. 1	Wickwire Y	Buffalo	85 x 21	140,000
———	Bethlehem F	South Bethlehem, Pa.	90 x 22	140,000
———	Bethlehem G	South Bethlehem, Pa.	90 x 22	140,000
———	Aliquippa No. 4	Woodlawn, Pa.	90 x 22	175,000
	Total in 1910, 13 furnaces			1,794,000
1911.				
June 8	Haselton No. 4	Youngstown	85 x 21½	150,000
July 17	Central D*	Cleveland	.. ..	150,000
———	River No. 2†	Cleveland	83 x 20¼	125,000
———	Josephine No. 2†	Josephine, Pa.	85 x 20	140,000
	Total in 1911, 4 furnaces			565,000

*United States Steel Corporation furnaces.
†Merchant furnaces.

The distribution as to ownership of above furnaces is as follows:	No.	Capacity.	Percentage.
United States Steel Corporation	25	3,855,000	38.7
Independent steel interests	26	4,020,000	40.3
Merchant interests	22	2,094,000	21.0
Total	73	9,969,000	100.0

Financial Happenings of the Year Just Closed

Record Bank Clearings Indicate That Trade was Better Than Supposed—Many High Marks Established

While it is still too early to fully appreciate the significance of developments in the financial world during the year just closed, that period, in many important respects, may be described as one of disappointed hopes. When 1911 was ushered in, there was good reason to believe that the long expected financial and industrial recovery was at hand, and that the period of drastic liquidation which followed the premature boom of 1909 had run its course. In its general aspect, however, 1911 seemed but a long continuation of 1910, and it was only toward the very close of the year that there became visible any signs of improvement.

Like 1910, the past year witnessed the establishment of many new high marks. These included the figures for the country's money supply, national bank circulation, the amount of gold in the treasury vaults, national bank deposits and government revenue receipts, for a single month. Of especial interest was the total of the country's bank clearings, outside of New York, this figure surpassing all previous records. According to this evidence, the volume of trade in the country was greater during the past 12 months than was generally supposed. Another total of unusual interest was that of the interest and dividend disbursements which exceeded that of any other year in our history. While imports of merchandise in this country were second only to 1910, exports for the first time crossed the two-billion-dollar mark, although no single monthly export total established a maximum. During the year, New York banks loaned fully $150,000,000 to European markets, this being the consequence of dull trading and heavy liquidation, which made possible the accumulation of unusually large bank reserves.

The year 1911 was characterized by inactive and uncertain financial markets, with an undertone of hopefulness, until the end of July, when a great selling movement set in on the New York stock exchange, demoralizing the market during two or three months ensuing. Another extremely unsettled period was brought on in Wall street following the rumor of the government's impending suit against the Steel Corporation; when the suit was actually filed, however, a very brief decline was followed by a heavy buying movement, accompanied by a 10 to 15-point rise throughout the entire list.

	Closing Dec. 31, 1910.	Closing Dec. 30, 1911.	Changes in 1911.	†† At present price.	Basis.	Dividend Last Dividend	Dividend Date Last Div. Pay	
Allis-Chalmers	8	1½	— 6½	.....	.....	.....		
Allis-Chalmers, pr	29	7½	—21½	.....	7 cum.	1¾ Q.	Feb.,	1904
American Can	8⅝	11¾	+ 2¾	.....	.....	.....		
American Can, pr	77½	92½	+15	5.4	7 cum.	1¼ Q.	Jan.,	1912
Am. Car & Fdy	50¾	54	+ 3¼	3.7	2	½ Q.	Jan.,	1912
Am. Car & Fdy., pr	114⅜	117¼	+ 2⅞	6.0	7 n. c.	1¾ Q.	Jan.,	1912
American Loc	38½	36¼	— 2¼	...	5	1¼ Q.	Aug.	1908
American Loc., pr	108	105⅞	— 2⅛	6.6	7 cum.	1¾ Q.	Jan.,	1912
American Ship	75	49½	—25½	...	4	2 Q.**	June,	1911
American Ship, pr	111	105	— 6	6.7	7 n. c.	1¾ Q.	Jan.,	1912
Am. Steel Foundries	43⅝	33	—10⅝	...	5	1¼ Q.	May,	1911
Barney & Smith	20	15	— 5	...	4	1 Q.	Dec.,	1907
Barney & Smith, pr	85	70	—15	11.4	8 cum.	2 Q.	Dec.,	1911
Bethlehem Steel	29	31⅞	+ 2⅞	...	.....	.....		
Bethlehem Steel, pr	59	60¾	+ 1¾	...	7 n. c.	¾ Q.	Feb.,	1907
Cambria Steel	42½	44½	+ 2	5.6*	5	1¼ Q.	Nov.,	1911
Cambria Iron	45	44	— 1	4.6*	4	2 S. A.	Oct.,	1911
Chicago Pneumatic Tool	41⅞	46¼	+ 4⅜	8.7	4	1 Q.	Jan.,	1912
Colorado Fuel	31⅛	26½	— 4⅝	...	.....	1¾ Q.	April,	1902
Crucible Steel	12¼	12¼	.....	...	.....			
Crucible Steel, pr	74⅞	82⅞	+ 8	8.4	7 cum.	1¾ Q.	Dec.,	1911
Empire Steel	7	5	— 2	...	.....	.....		
Empire Steel, pr	51	40	—11	10.0	6 cum.	2 S. A.	July,	1911
Fay & Egan	70	70	.....	...	7 cum.	1¾ Q.	Nov.,	1908
Fay & Egan, pr	115	110	— 5	6.4	7 cum.	1¾ Q.	Nov.,	1911
General Electric	151	153	+ 2	5.2	8	2 Q.	Jan.,	1912
Harbison-Walker	32¼	40	+ 7¾	5.0	2	½ Q.	Dec.,	1911
Harbison-Walker, pr	94	99	+ 5	6.1	6 cum.	1½ Q.	Oct.,	1911
International Pump	40¼	33¼	— 7	...	.....	½ Q.	Apr.,	1908
International Pump, pr	85	83	— 2	7.2	6 cum.	1½ Q.	Nov.,	1911
Lackawanna Steel	35	30	— 5	...	.....	.....		
Lake Sup. Corp	29	27	— 2	...	.....	.....		
New York Air Brake	75	56	—19	...	6	1½ Q.	July,	1911
Niles-Bement-Pond	98	94	—4	6.4	6	1½ Q.	Dec.,	1911
Niles-Bement-Pond, pr	104	104	.....	5.8	6 cum.	1½ Q.	Nov.,	1911
Otis Elevator Co	48	71½	+23½	5.6	4	1 Q.	Jan.,	1912
Otis Elevator Co., pr	97	96	— 1	6.3	6 n. c.	1¼ Q.	Jan.,	1912
Pa. Steel	60	60	.....	...	.....	.....		
Pa. Steel, pr	104	102½	— 1½	6.9	7 n. c.	3½ S. A.	Nov.,	1911
Pittsburgh Coal	17	18½	+1½	...	.....	.....		
Pittsburgh Coal, pr	68½	83¼	+14¾	8.4	7 cum.	1¾ Q.	Jan.,	1912
Pittsburgh Steel Co., pr	103	101	— 2	6.9	7 cum.	1¾ Q.	Dec.,	1911
Pressed Steel Car	30	33½	+ 3½	...	.....	1 Q.	Aug.,	1904
Pressed Steel Car, pr	93	100	+ 1	7.0	7 n. c.	1¾ Q.	Nov.,	1911
Pullman	159	159½	+ ½	5.0	8	2 Q.	Nov.,	1911
Railway Stl. Spring	32	31	+ 1	...	2	1 S. A.	Oct.,	1908
Railway Stl. Spring, pr	91¾	98½	+ 6¾	7.1	7 cum.	1¾ Q.	Dec.,	1911
Rep. Iron & Steel	30½	26½	— 4	...	.....	.....		
Rep. Iron & Steel, pr	92½	84¼	— 8¼	8.3	7 cum.	1¾ Q.	Jan.,	1912
Sloss-Sheffield	49¼	42½	— 6¾	...	5	1¼ Q.	Sept.,	1910
Sloss-Sheffield, pr	114½	112	— 2½	6.3	7 n. c.	1¾ Q.	Jan.,	1912
U. S. Pipe & Fdy. Co	16½	16	— ½	...	.....	1 Q.	Dec.,	1907
U. S. Pipe & Fdy. Co., pr	51½	50¾	— ¾	...	.....	1¼ Q.	June,	1911
U. S. Steel	72⅛	67⅜	— 4¾	7.5	5	1¼ Q.	Dec.,	1911
U. S. Steel, pr	116⅝	111	— 5⅝	6.3	7 cum.	1¾ Q.	Nov.,	1911
U. S. Steel 5s	104	101¾	— 2¼	4.9	5	.....		
Va. Iron, Coal & Coke	50	83	+33	...	.....	5. †	Oct.,	1907
Westinghouse Electric	65½	65¾	+ ¼	5.3*	7 cum.	1¾ Q.	Jan.,	1912
Westinghouse Air Brake	139	154	+15	6.5*	.....	5 Q.‡	Jan.,	1912

Par value of shares, $100, except those starred (*), $50.
**Includes last 1 per cent payment of 4 per cent extra.
†Stock.
‡Includes 2½ regular, 1½ extra and 1 special.
††Net yield.

Trading on the New York stock exchange during the year, however, was not characterized by as violent fluctuations in security prices as occured in 1910. This was especially the case with the more prominent iron and steel issues, as shown in the accompanying chart. The high and low prices for the year for some of these issues were as follows: Pullman, 163 on Jan. 30 and 154 on Sept. 23; General Electric, 168⅜ on May 29 and 142 on Sept. 22; United States Steel preferred, 120⅞ on Feb. 4 and 103 on Oct. 7; Pressed Steel Car preferred, 102¾ on June 16 and 91 on Sept. 21; Republic Iron & Steel preferred, 99⅜ on Feb. 1 and 74⅛ on Oct. 27; United States Steel common, 82⅛ on Feb. 6 and 50 on Oct. 27 and Westinghouse Electric, 79 on May 29 and 58⅝ on Sept. 25. Securities which suffered the greatest reductions in prices during 1911 were Allis-Chalmers, both common and preferred; American Ship, common; American Steel Foundries; Barney & Smith, preferred; Empire Steel, pre-

ferred, and New York Air Brake. American Can, preferred; Otis Elevator, common; Virginia Iron, Coal & Coke and Westinghouse Air Brake securities all showed substantial advances.

Political agitation, both at home and abroad, was a decidedly unfavorable influence. The complications which at one time threatened to embroil France, England and Germany in actual war, were attended by acute disturbance in European financial and security markets. An actual panic occurred in Berlin, on Sept. 2, as the result of the withdrawal of French capital loaned in Germany. In this country, opinions of great moment were handed down by the supreme court in its decisions, in May, against the American Tobacco Co. and the Standard Oil Co. These decisions were well received in financial circles. Among the unfavorable influences were labor troubles, which occurred both at home and abroad, and the great uncertainty which existed in this country concerning agricultural crops. The grain yield finally proved to be fair, while the cotton harvest totaled the unparalleled figure of 15,000,000 bales.

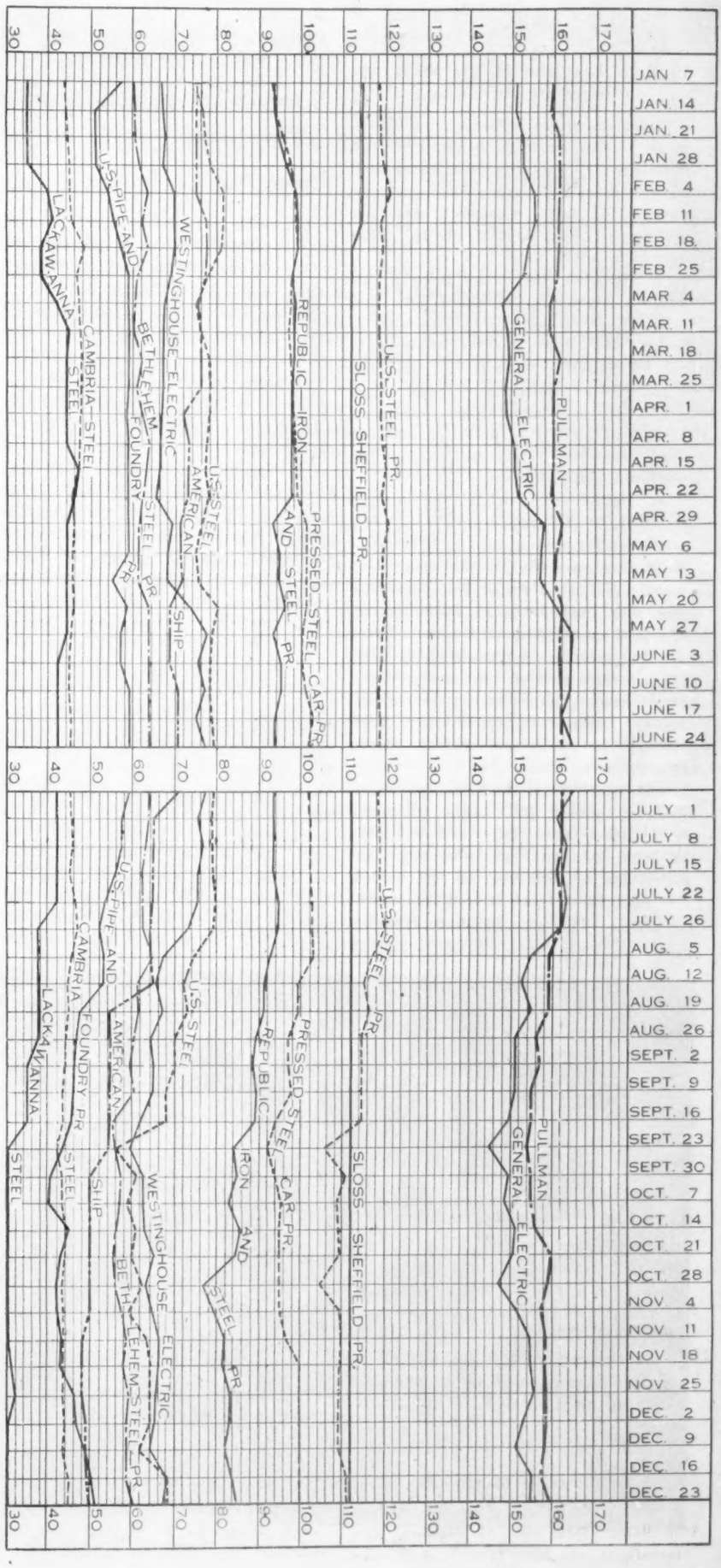
The following statistics indicate the general tendencies which characterized the year:

The number of shares sold on the New York stock exchange was 128,746,115, compared with 165,331,748 in 1910, and 215,198,510 in 1909. Bonds were sold on the stock exchange to the amount of $888,941,000, compared with $645,703,000 in 1910, and $1,306,329,000 in 1909.

Commercial failures for the year were 13,368, compared with 12,652 in 1910, and 12,807 in 1909; but liabilities in 1911 were $187,626,516, compared with $201,757,097 in 1910, and $151,752,093 in 1909.

The railroads of the country laid 3,066 miles of new main line track during 1911, compared with 4,122 miles for 1910, 3,748 miles in 1909, and with 12,876 miles in 1887, the maximum. Five railroads were thrown into receivership during 1911, compared with seven in 1910 and five in 1909. Mileage involved was 2,606, compared with 735 in 1910, and 859 in 1909. The Wabash receivership was responsible for all but 91 of the mileage involved in 1911. The orders for railway equipment included specifications for 72,161 freight cars; of these, 60,000 were ordered in the last seven weeks of the year. The total freight cars ordered compared with 180,945, in 1910.

The cost of living, as indicated by the prices of commodities, reached the highest level in 30 years, the *London Economist's* index number for Dec. 1, 1911, being 2,607.



FLUCTUATIONS OF LEADING INDUSTRIAL STOCKS IN 1911.

SCRAP MORE ACTIVE

In Both East and Middle West, and Prices are Advancing.

There is more activity manifested in the scrap markets in the east and middle west, and prices are advancing. Several large companies have made inquiries for large tonnages, and are willing to pay prices above those quoted a week ago.

In Pittsburg there has been a fair amount of buying in small lots, and some contracts have been extended to cover the first quarter. Shipments of old material during the next ten days will be quite heavy, and while prices are not any higher, they are very firm, and it is doubtful whether much material could be had at the minimum quotations.

In Philadelphia, while the market is quiet, it is exceedingly firm, and considerable buying activity will probably develop early in the new year. A sale of 1,000 tons of heavy melting steel has been made at $12.50, Elizabethport, and $13, delivered. Some of the largest eastern steel makers still have a heavy tonnage of steel scrap under purchase made several months back, and in one case 25,000 tons is yet to come in from these transactions.

The firmness with which prices of scrap are being held in the Cleveland district is largely due to the increased demand for heavy melting steel and busheling. A demand for heavy steel has also come from immediate outside territory, that has carried a premium over local prices, shipments beginning at once.

The local market at Seattle is more active, due to the absence of the influx of Hawaiian scrap, caused by the increase in water shipping rates. Foundries are also finding that domestic scrap is better in quality than the recent Hawaiian imports, and dealers are shipping piles that have remained stationary for many months.

Pig Iron Firm Dissolves

New York, Jan. 2. (By wire.)—The firm of Nash, Isham & Co., 55 Liberty street, dealer in pig iron and coke, dissolved Jan. 1, and Albert L. Nash becomes a member of the firm of Crocker Bros. Phillips Isham will continue business under his own name, handling the same irons as the former firm.

Sale of Wabana Ore

New York, Jan. 2. (By wire.)—Sales of about 75,000 tons of Wabana, Newfoundland, ore have been made to eastern furnaces for shipment this year. While the prices have not been made public, it is understood that this ore will sell lower than last year, when 7⅜ cents per unit, Philadelphia, was obtained.

Upson Nut Co. Properties Taken Over

The formal taking over of the properties of the Upson Nut Co. incorporated under the laws of Connecticut, by the newly formed Upson Nut Co., incorporated under the laws of Ohio, the majority of the stock of which is owned by the Bourne-Fuller Co., Cleveland, took place, Saturday, Dec. 30, at the Citizens Bank building, Cleveland. The officers of the new company are H. A. Fuller, president; W. A. Hitchcock, first vice president; B. F. Bourne, second vice president and treasurer, and Norris J. Clarke, secretary. Messrs. Fuller and Bourne have long been officers of the Bourne-Fuller Co., and Mr. Hitchcock has been president of the Upson Nut Co. since the death of A. S. Upson. Mr. Clarke entered the employ of the Bourne-Fuller Co. when only 14 years of age, and seven years ago became Pittsburgh manager of that company. He will be succeeded in the Pittsburgh office by W. W. Williams, now St. Louis manager of the Bourne-Fuller Co.

The property taken over consists of a blast furnace at Cleveland with a capacity of about 90,000 tons annually; a steel plant in close proximity with four 60-ton open-hearth furnaces and blooming mill, billet mill and merchant mills and extensive nut, bolt and rivet works both at Cleveland and Unionville, Conn.

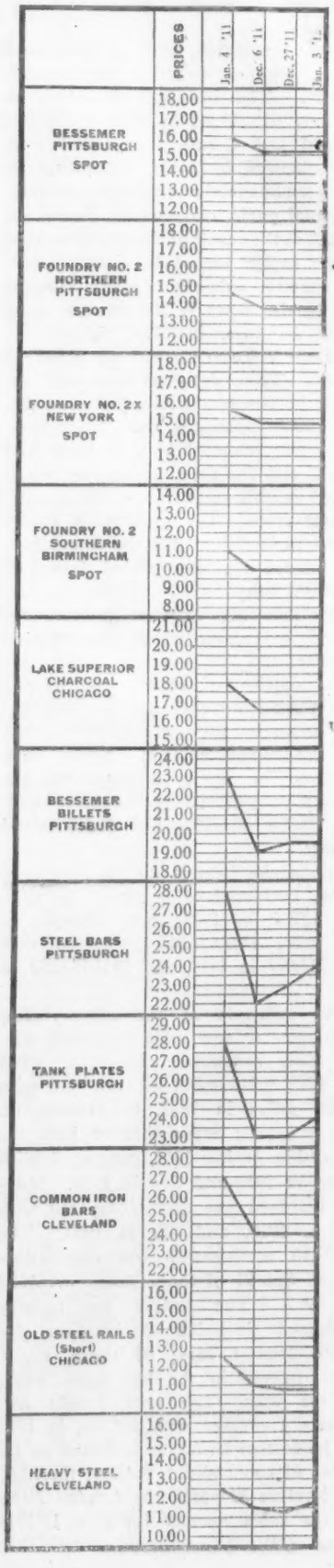
Increasing Production of Steel Corporation

New York, Jan. 2. (By wire.)—With the ordering in today of three additional furnaces, one south Sharon, one Mingo and one Edgar Thomson, all serviceable furnaces of the Steel Corporation in the Pittsburgh district are going into operation. Eight stacks have been put in as ordered in the past week. Two Ohio, one New Castle and two Edgar Thomson resumed in the past few days.

Early in the new year, the Corporation's mill and furnace operations will be very heavy and may reach 90 per cent.

The Frederick Kahl Iron Co. has been organized at Detroit and incorporated with $100,000 capital stock.

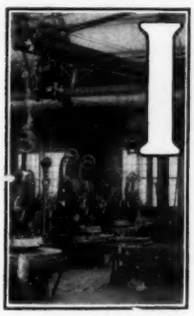
PRICE CHART



Flexibility of Operations in Machine Shops

A Discussion of the Ideal Arrangement of Tools That Will Effect the Greatest Manufacturing Economies

By C A Tupper



IN A large machine shop, where a great variety of operations must be carried on simultaneously and economy of space is an important consideration, one of the features greatly to be desired, but at the same time, one of the most difficult to obtain, is flexibility of service within confined working areas in such a manner as to render each part of the shop practically an independent unit.

Introduction of motor drive, with its manifold advantages, has undoubtedly done much to accomplish the desired ends. As a natural consequence, the tendency has been to lay too much emphasis upon what can, after all, be regarded as no more than one good feature of modern engineering practice in the construction, equipment and general layout of the work in a shop.

Of fully as much or greater importance is the arrangement of the tools in their proper relation to the progress of the work, from the time the rough castings are delivered by the foundry until the machined parts are assembled for erection.

In illustration of the idea intended to be conveyed, the writer wishes, first of all, to direct attention to the illustrations shown in Figs. 1, 2 and 3, each of which was taken in a different plant. As a whole, they represent good mechanical arrangement, while in contrast to them is the crowded, cluttered condition shown in another shop, Fig. 4. The view in the latter is necessarily restricted, on account of the difficulty experienced in placing a camera, but sufficient detail is shown to reveal very plainly the lack of system in the layout of the plant.

Ideal Arrangement of Tools

Fig. 5 shows the long central aisle of one of the shops of a leading engine building establishment of the central west, nearly every tool in which is either portable or so situated and arranged as to serve many of the purposes of such a tool. Furthermore, the tools are placed in such relation, one to another, that all operations come in their natural sequence, and the work progresses from one machine to the next in order or is worked upon by several tools at a time, in such a manner that the transportation, lifting, staying, lining-up and other labor usually regarded as unavoidable, is actually reduced to a *minimum*—so much so that the use of that abused term is fully justified. The work gradually moves towards the erecting shop at the end without any retrograde motion whatever, and with practically no loss of time, reaching that point in a finished condition for final assembling.

On the left, Fig. 5, are shown the stationary tools, such as planers, boring mills, lathes, etc., together with much special apparatus, while at the right are machines arranged along a steel floor plate in such a fashion that they may be set for any position and any alignment in relation to the work. This floor plate is the progenitor of all such arrangements as shown in THE IRON TRADE REVIEW, June 29, page 1248, having been the first of the kind ever installed on a large scale, and the economies effected by its use during nearly ten years past have been enormous.

It will now be interesting to follow the progress of a large piece of work

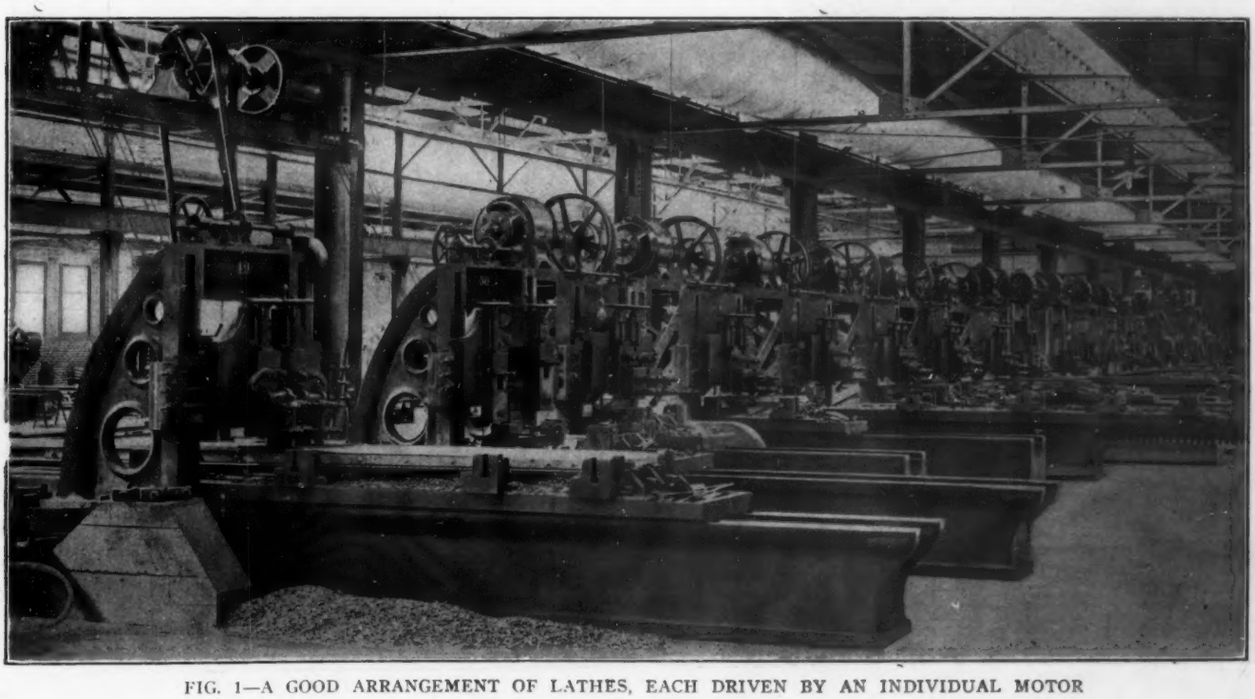


FIG. 1—A GOOD ARRANGEMENT OF LATHES, EACH DRIVEN BY AN INDIVIDUAL MOTOR

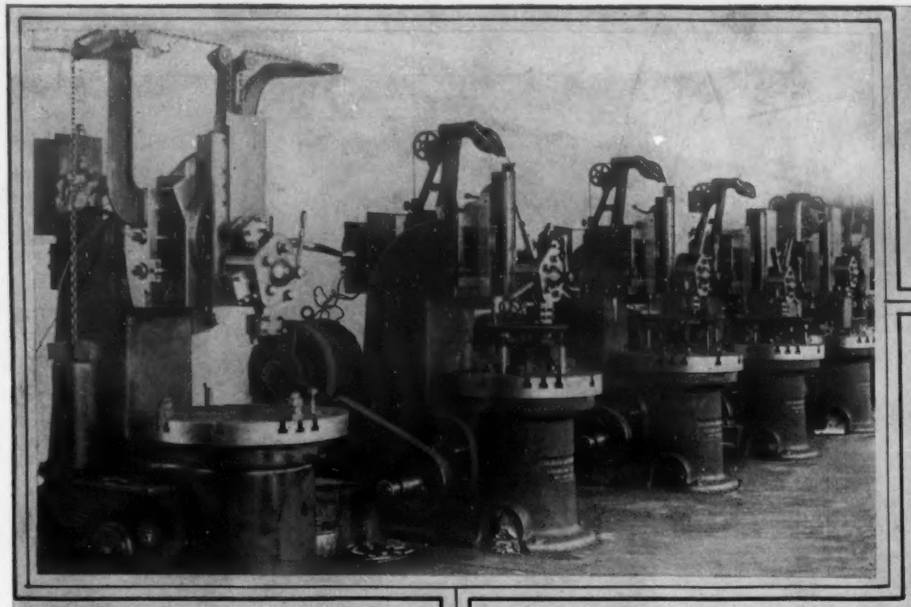


FIG. 2—A GOOD ARRANGEMENT OF COLBURN BORING MILLS; EACH TOOL IS MOTOR-DRIVEN

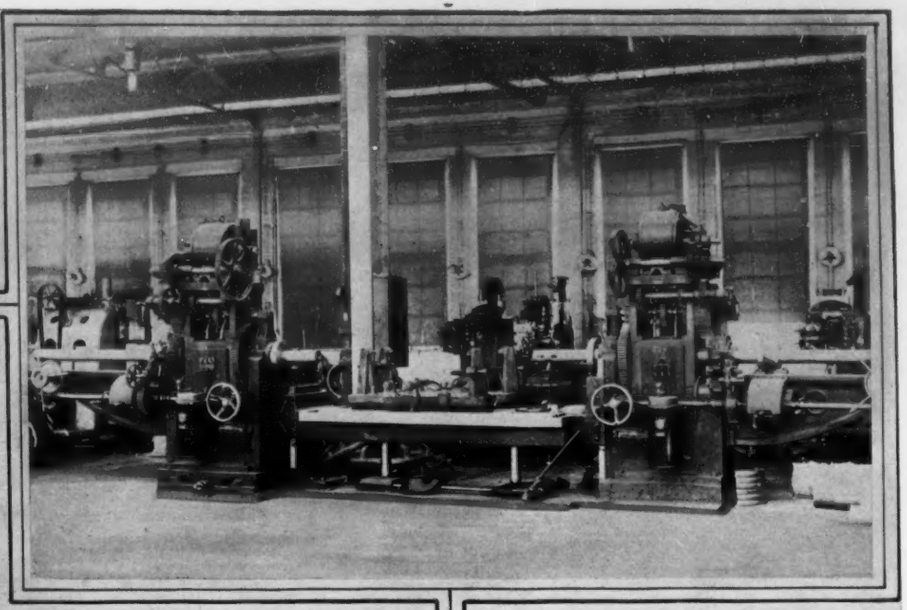


FIG. 3—ANOTHER GOOD ARRANGEMENT OF MACHINE TOOLS

FIG. 4—AN EXAMPLE OF A POOR ARRANGEMENT OF MACHINE TOOLS

FIG. 5—MIDDLE BAY OF A LARGE PLANT, SHOWING GOOD ARRANGEMENT OF HEAVY TOOLS

through the shop. In Fig. 10 is illustrated the bed, frame and slide, cast in one piece, of a large blowing engine, which weighed in the rough 105 tons. It required two cranes to handle this, and the illustration shows the piece just being placed in position on the planer which appears in the foreground of Fig. 5. With this machine the straight upper edges of the main bearings are finished.

For the following operations the casting is swung by the cranes directly across the aisle and set down on the floor plate, to be worked upon by the portable draw shaper illustrated in Fig. 9. Here all straight surfaces on the bearing, slide, bosses, etc., that need finishing are machined. In consequence of the size of the piece, lining-up on the floor plate is not attempted, and there is no necessity for doing so, as the tool itself can be adjusted to meet every possible requirement of the work. Similar tools, of a larger, heavier type, designed by the same builders, the Morton Mfg. Co., Muskegon Heights, Mich., are in service in other shops of the same plant, and they have been put to a great variety of service with very satisfactory results.

Fig. 7 shows a special boring bar which is used for finishing the main bearing. Fig. 11 is an illustration of the casting reversed and suitably blocked up to be worked upon by another special boring machine, with facing and milling attachments, manufactured for this shop by the Niles Tools Works. Besides facing the end of the casting in the position indicated, the principal result here to be accomplished is to have the interior surfaces of the slide bored as two absolutely identical, concentric arcs, and the use of this machine is a very trustworthy means of attaining that end. In Fig. 8 the tool is shown facing the bed plate of a heavy duty power engine, and its details may be clearly seen.

After being faced and bored, the casting is taken to a large, rotary planer, shown in Fig. 6. This is a twin machine; either part can be used separately or both simultaneously. For the casting whose progress we have been following, the exterior side surfaces of the main bearing are machined at one setting; and then, unless there is something unusual in the design requiring further operations, the piece is sent directly to the erecting shop. Any minor operations, such as drilling, slotting, milling, etc., including those of parts difficult of access, have already been performed during the progress of the piece; and, by the use of portable tools, which can be grouped as desired, several of these processes may be under way at the same time. An example of this is illustrated in Fig. 12, where two Niles-Bement-Pond vertical radial drills, a Betts slotter, the boring bar shown in Fig. 7 and a new type of horizontal drilling machine, developed by the Pawling & Harnischfeger Co., Milwaukee, are working together on the one casting.

Meanwhile, the steam and air cylinders have been carried through a similar set of operations, including the boring and turning shown in Fig. 13, and the finishing of the valve ports by the special twin machine illustrated in Fig. 15. Both of these were built by the Niles Tool Works, and the latter is particularly noteworthy, as it works upon two ports at a time. When these are finished, the cylinder is quickly reversed by the crane so as to give access to the other two. Forgings for the shafts, rods, etc., are, at the same time, being turned, ground, etc., in an adjacent department.

The views represented in the various illustrations do not, of course, show parts of the same engine throughout, as they were taken on different occasions, but the similarity is sufficient to show the line of progress from one tool to another. Neither do the operations have to be performed in the same order or with the

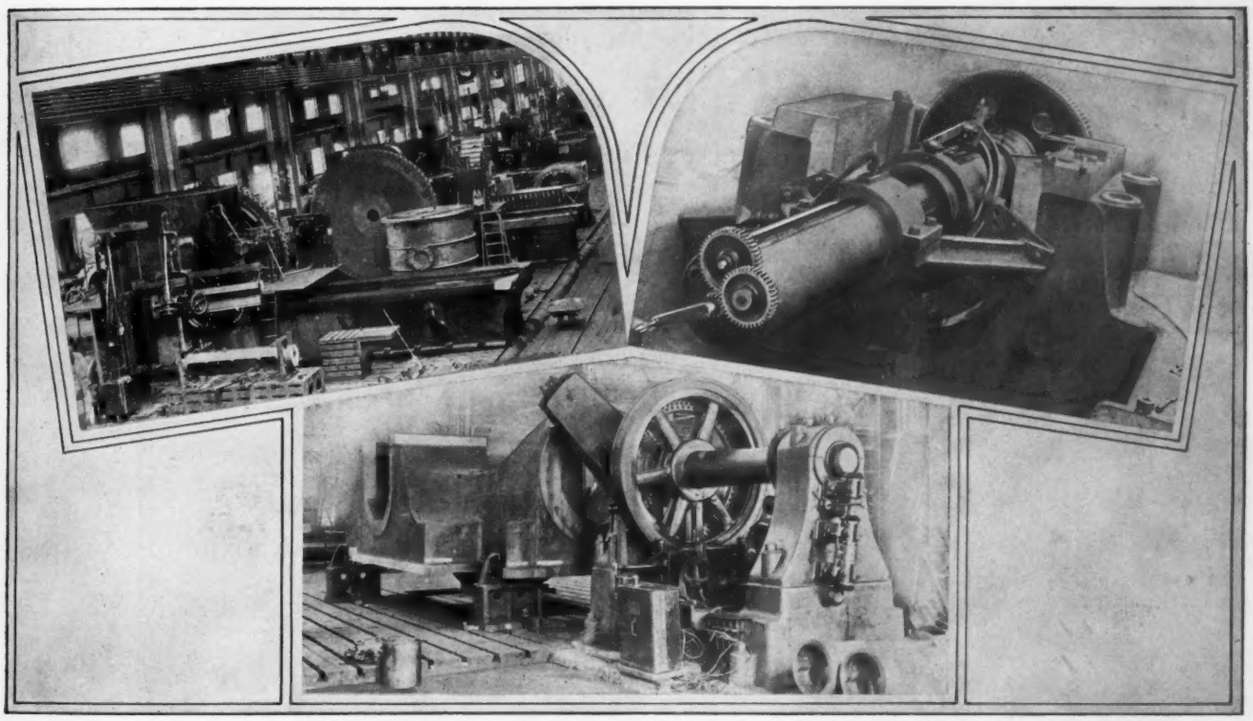
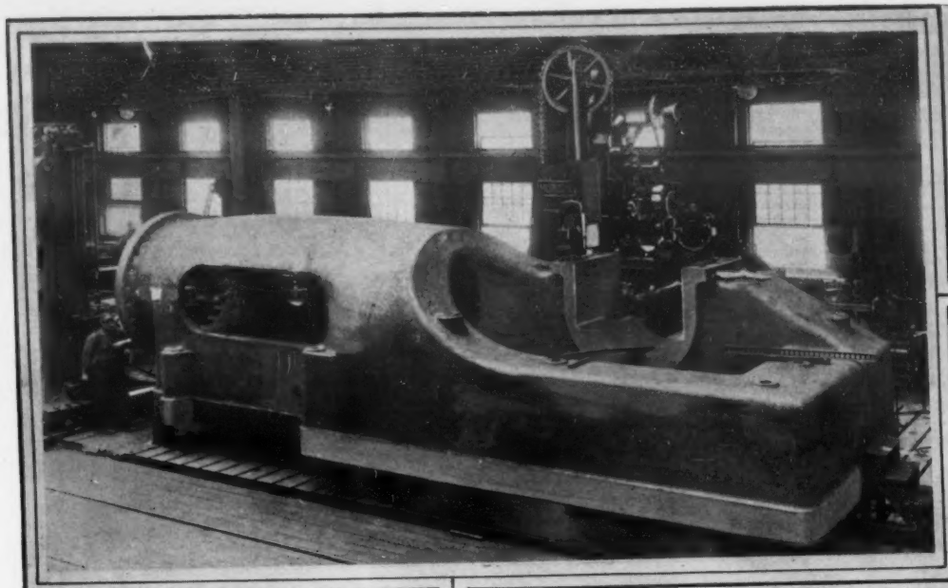
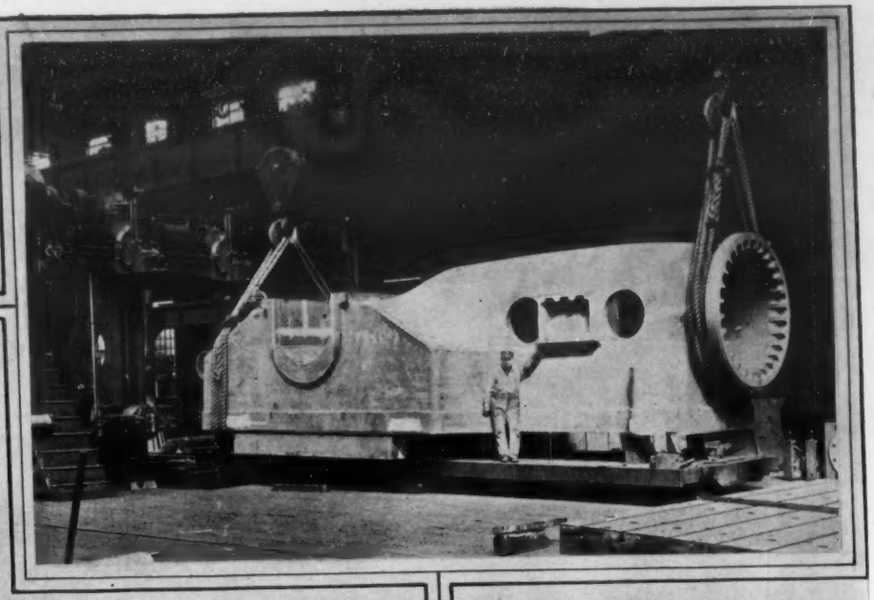


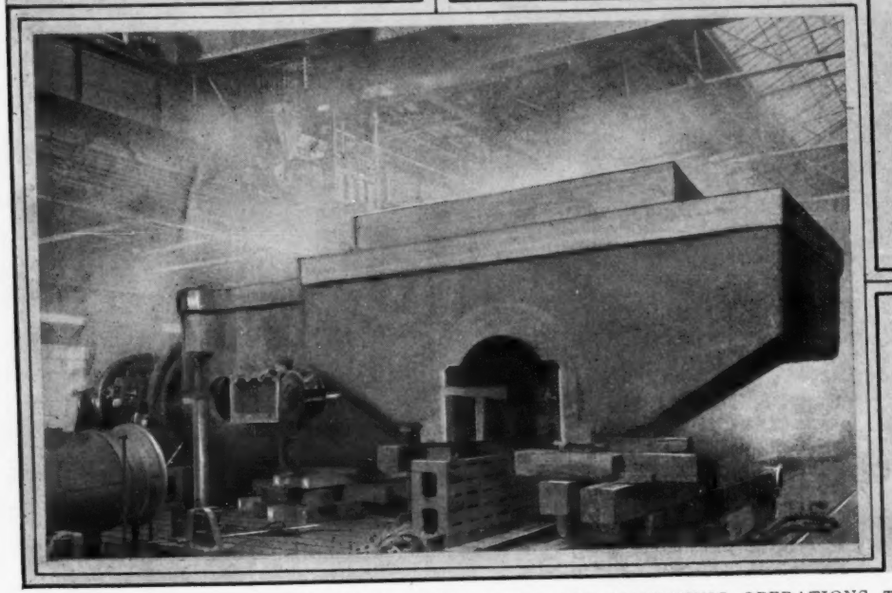
FIG. 6—LARGE ROTARY PLANER. THIS IS A TWIN MACHINE AND EITHER PART CAN BE USED SEPARATELY OR SIMULTANEOUSLY

FIG. 7—SPECIAL BORING BAR USED FOR FINISHING THE MAIN BEARING OF A LARGE BLOWING ENGINE BED

FIG. 8—FACING A LARGE BED PLATE WITH A BORING MACHINE EQUIPPED WITH FACING AND MILLING ATTACHMENTS







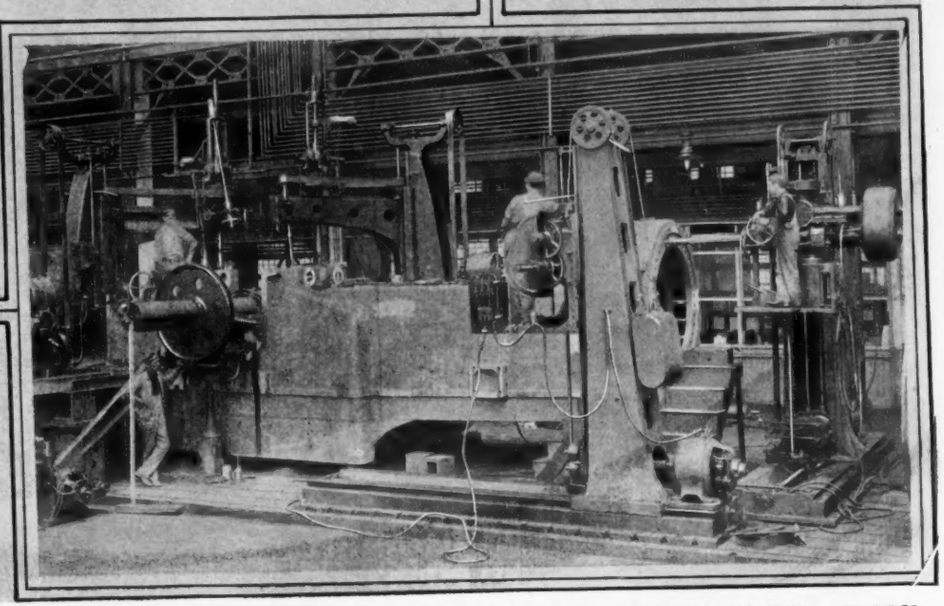


FIG. 9—LARGE CASTING ON A FLOOR PLATE FOR MACHINING OPERATIONS TO BE PERFORMED BY A DRAW SHAPER

FIG. 11—BLOWING ENGINE BED CASTING REVERSED FOR OPERATIONS BY A BORING BAR WITH FACING AND MILLING ATTACHMENTS

FIG. 10—LARGE BLOWING ENGINE BED CASTING, WEIGHING 105 TONS, IN POSITION ON A PLANER

FIG. 12—TWO VERTICAL RADIAL DRILLS, SLOTTER, BORING BAR AND HORIZONTAL DRILLING MACHINE OPERATING SIMULTANEOUSLY ON A LARGE ENGINE BED CASTING

machines mentioned, as the system in use is sufficiently flexible to admit of considerable variation in that respect. This is governed by the character and quantity of other work in the shop. The principal end to be achieved is to keep all of the details in harmony and to arrange them in the most economical relation allowed by circumstances. Each tool should, of course, be used as far as possible for the work that it is best adapted to perform, but no hard and fast rules can be laid down, and the particular requirements of each week must be carefully considered. A difference of management in this one respect will frequently turn losses into profits, or vice versa.

A notable feature of the shop last illustrated is the absolute elimination of shafting except in the galleries, where a large number of very light tools are at work. All of the power required is applied by means of electric motors and pneumatic devices of various kinds, supplied through wires and pipes from a central power plant during the day. At night electric current is still available; but for overtime work, where compressed air is needed, the portable equipment shown in Fig. 14 is used. This consists of an Allis-Chalmers compressor, such as is generally used for air brake service, mounted on an ordinary truck and driven by a direct current electric motor, the base of which forms the top of the compressor. Connection to the motor can be plugged in at any one of a number of convenient points throughout the shop, where sockets have been placed for the purpose, and the motor operates only long enough to keep the air in the storage tank, which is also mounted on the truck, at the required pressure. When the supply falls below that pressure an automatic governor starts the motor and again cuts it out when the tank supply has been renewed. The general features of a similar system operated in connection with a heavy counterbalance, with its automatic control, have previously been well known, but the portable arrangement is comparatively new and bids fair to come into quite common use.

The illustrations shown, with their accompanying explanation, are chiefly of value for what they suggest, not least of which is this, that foremost in the designing of a new shop, or the remodeling of an existing plant, should be the *mechanical* arrangement. If electric drive is introduced, the plan should be arranged by some one versed in both the mechanical and electrical requirements of the service. Otherwise, the best results cannot be expected, and even slight differences in operating economy make a large aggregate on one or the other side of the ledger during the year.

Electrical enthusiasts, and particularly motor salesmen who offer gratuitous counsel to customers with the intimation that it is worth just as much as the paid opinion of a consulting shop engineer, are apt—in all sincerity—to present advantages of electric drive in a light so dazzling as to obscure other considerations, such as first cost, maintenance and particular suitability of installations for the work.

A striking example of both phases of the matter recently came to the attention of the writer. In the natural growth of its business a firm of manufacturers required more power for the operation of both metal and wood-working machinery, particularly as an extension was planned. The superintendent suggested that it would be a good time to look into the merits of electric drive, and accordingly the representatives of two

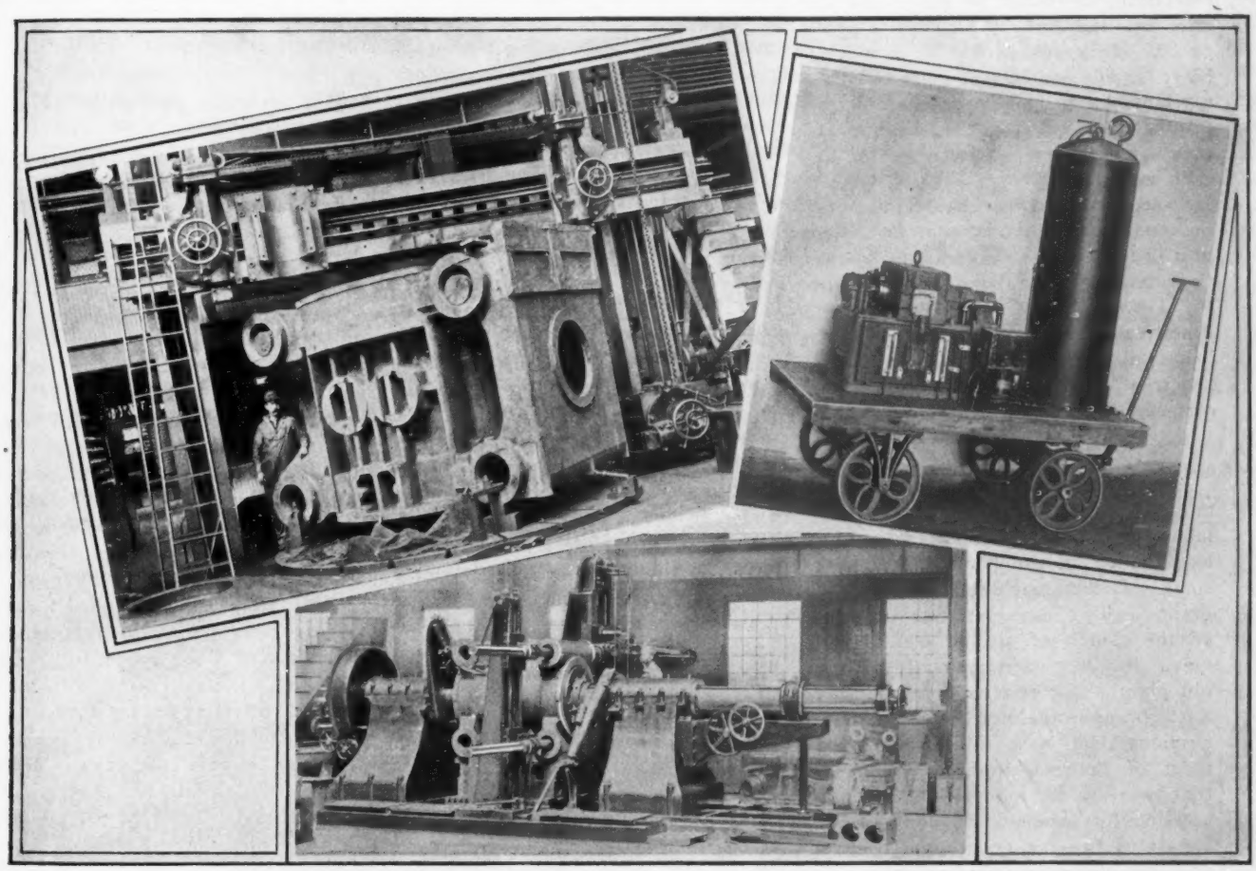


FIG. 13—TURNING AND BORING ONE OF THE CYLINDERS

FIG. 14—A PORTABLE AIR COMPRESSOR OUTFIT

FIG. 15—SPECIAL MACHINE FOR FINISHING VALVE PORTS WHICH OPERATES ON TWO PORTS SIMULTANEOUSLY

motor-building concerns were called in. Each exhibited immediate enthusiasm over the subject, extolled the advantages of his system, especially direct individual motor drive and, without attempting to make a careful survey of the mechanical requirements of the plant or testing the machines then in operation to ascertain the amount of horsepower which each one actually pulled from the shaft, they prepared a detailed estimate of the electric generating unit, motors, wiring, etc., required. The figures, both separately and as totals, differed, but in one thing the *sales-engineers* were agreed, that the entire establishment should be remodeled at once on the basis which they proposed. They conceded that it would be desirable to drive a few light machines in groups from short lines of shafting, but for the most part they advocated a separate motor to each machine.

So convincing were the arguments of these electrical experts that the firm had almost decided to adopt their suggestions, and divide the order between them, when the representative of a third motor-builder heard of the situation and came to see what there might be in it for his company.

Group Drive Adopted

After examining the sketches tentatively agreed upon, this third man asked leave to make a careful examination of the plant and to test some of the machines, which was granted. Two days later he presented the sketch of a plan which provided for a re-arrangement of the old plant along relatively inexpensive lines, brought the new part into harmonious relations with it, and placed most of the machines, including all that were used intermittently, in a position for group drive, none of the apparatus being very heavy. The result was to reduce by a large percentage the size of the generating unit required, at the same time making ample allowances for overload capacity and future growth; to lessen the number and horsepower of motors needed, as well as auxiliary apparatus, wiring expense, etc.; to effect a material saving in time and labor of handling material; to economize floor space, and to enable work to be completed more quickly. Instead of *estimates* he had figures from the manufacturers of the metal and woodworking machines, as well as figures of his own, showing the amount of horsepower required for each size. These were mainly based on observations and tests in other similar establishments, and where any were not available he had tested the machines then running in the old shop. In short, he was able to demonstrate to the owners of this plant that he knew what he was talking about, and he secured the contract for the equipment.

Pneumatic Equipment

In connection with the shops specifically referred to, it is needless to expatiate on the advantages of electric and pneumatic operation, as shown by the illustrations, for they also are manifest. Nor do the excellent provisions made for light, heat and ventilation call for more than passing comment. What should rivet attention is the good, hard common sense exhibited in planning the progress of work through the shops shown, which is typical of the best American practice. Even without the electrical features of its layout, the plan of the equipment would, in each instance, still be notable for working economy.

A Novel German Traveling Crane

An installation of traveling cranes possessing novel features was recently made in the foundry of Thyssen & Co., Mulheim-on-Ruhr, Germany. The crane hook is suspended from a revolving jib carried underneath the crane girders, instead of being suspended from the traveling carriage on the top of the girders. This departure from the usual form of traveling crane was made with a view to increasing the range of the hook beyond the length of the crane girder, which spans the shop, thus enabling the crane to pick up loads inaccessible to cranes of ordinary construction. The carriage from which the jib is suspended travels across the shop on the top of the crane girders and is propelled by spur wheel gearing, operated by a motor. The hoisting mechanism with which the carriage is usually equipped is absent and in its stead a forged steel vertical shaft is suspended from its upper end in an easily accessible ball step bearing on the carriage. The free end of this steel shaft reaches below the crane girders and carries the revolving jib, which is counter-weighted by a platform extending to the rear of the point of suspension of the jib. On this platform the lifting gear is located, consisting of a motor, two spur-wheel gears and the rope drum for winding up the load.

The operating machinery thus acts as a counterpoise to the leverage of the weight suspended from the jib and, in addition to the machinery, the weight is further increased by blocks of concrete. The jib portion of the traveling crane is thus essentially the same as the ordinary jib crane fitted to a railroad car, the only difference being that the one is suspended from above, while the other is supported by a platform. In both cases counterbalancing is effected by a load carried on an extension at the rear of the jib. The revolution of the jib is accomplished by the motor which, by means of a worm and intermediate gearing, drives a vertical shaft, on the upper end of which is a pinion which meshes with a fixed gear wheel of a large radius, suspended from the overhead traveling carriage.

Revolving Jib

The operating mechanism is placed at the root of the jib and is off-center with the suspending shaft, giving the operator an uninterrupted view over the entire working field of the hook.

This revolving jib attachment is a great advantage in a foundry consisting of two parallel bays, as it permits the cranes in one bay to assist those in the other. In designing their new foundry, Thyssen & Co. made it not only possible for the cranes in one bay to assist those in the parallel bay, but also to transport material from one end of the foundry to the other. In order to accomplish this the two bays have been constructed without any center column and the crane runways are suspended from the roof trusses. This construction gives unobstructed floor space to the center shop and allows the combination jib and traveling crane to work together unhindered in the center of the shop. One of the bays is devoted to heavy work and the other to light castings. The heavy bay is served by two combination cranes of 30 tons capacity each and the small work bay by two cranes of 15 tons capacity each. The working speeds of all the cranes are the same, so that two or more can work together in lifting one piece. The crane girders which span the shop are secured against lateral deflections by the rigid construction of the traveling carriage from which the jib is suspended. The cranes were built and installed by the Deutsche Maschinenfabrik, Duisberg, Germany.

For casting small white metal objects an alloy known as Queens metal is very satisfactory. It is made as follows: Tin, 100 pounds; antimony, eight pounds; copper, four pounds, and bismuth, one pound.

Ore Dock With Storage Capacity of 50,000 Tons

New Steel Dock at Presque Isle, Mich., Has 200 Pockets and a Season's Shipping Capacity of 3,000,000 Tons

THE new concrete and steel ore dock of the Lake Superior & Ishpeming Railway Co., at Presque Isle, Mich., which has been under construction during the past summer will be ready for business when navigation opens in the spring. This dock has the distinction of being the highest on the lakes and has been designed to accommodate the increasing dimensions of vessels plying in the ore trade. The dock which it supplants, though not by any means an old one, had grown inadequate owing to the rapid changes taking place in lake trade. The modern freighter begins to pump out her water ballast when she is within three or four hours' distance of her dock, and she is pretty high out of the water when she actually gets under the spouts. Difficulty has been experienced at some of the docks in getting sufficient slope to the spouts to make the ore flow freely, and this was the case with the old dock at Presque Isle. No difficulty from that source need be anticipated from the new dock, however.

The new dock is 2 feet higher than the new dock No. 6, of the Duluth & Iron Range Railway Co., at Two Harbors, which in itself is 6 feet higher than dock No. 5 belonging to the same company. The character of the dock is very clearly shown in the illustrations accompanying this article, being very substantial and designed for fast loading.

Dock Capacity

Work upon the dock was begun March 29, 1911, the contractor for the substructure being the Raymond Concrete Pile Co. The Wisconsin Bridge & Iron Co. furnished the steel and erected the superstructure. The dock proper has a length of 1,200 feet and with its approach is 1,873 feet. There are 200 pockets, 100 on each side with a capacity of 250 tons each, making the storage capacity of the dock 50,000 tons. Its maximum shipping capacity in a full season is estimated at 3,000,000 tons. It is characteristic of the ore trade that the storage capacity of the ore dock is but a small proportion of its shipping capacity, revealing the rapidity with which the moving parts are handled.

The dock is built upon wooden piles, as shown at *A*, Fig. 4, which were driven 3 feet centers and cut off 4 inches below low water. Sheet piling was placed outside and the enclosure filled with sand to within 6 inches of the top of the piles. This was covered with a 2½-foot concrete slab reinforced with 1½-inch cables. The concrete piers extend 1½ feet below and 5 feet above water level. The method of setting the steel columns in the concrete piers was quite simple, the columns being erected on the piers, and the concrete simply poured around them. Fig. 4, *D*, shows the abrupt slant of the ore pockets and with such pitch there is little likelihood of the ore jamming. In fact, the height from water level to hinge of

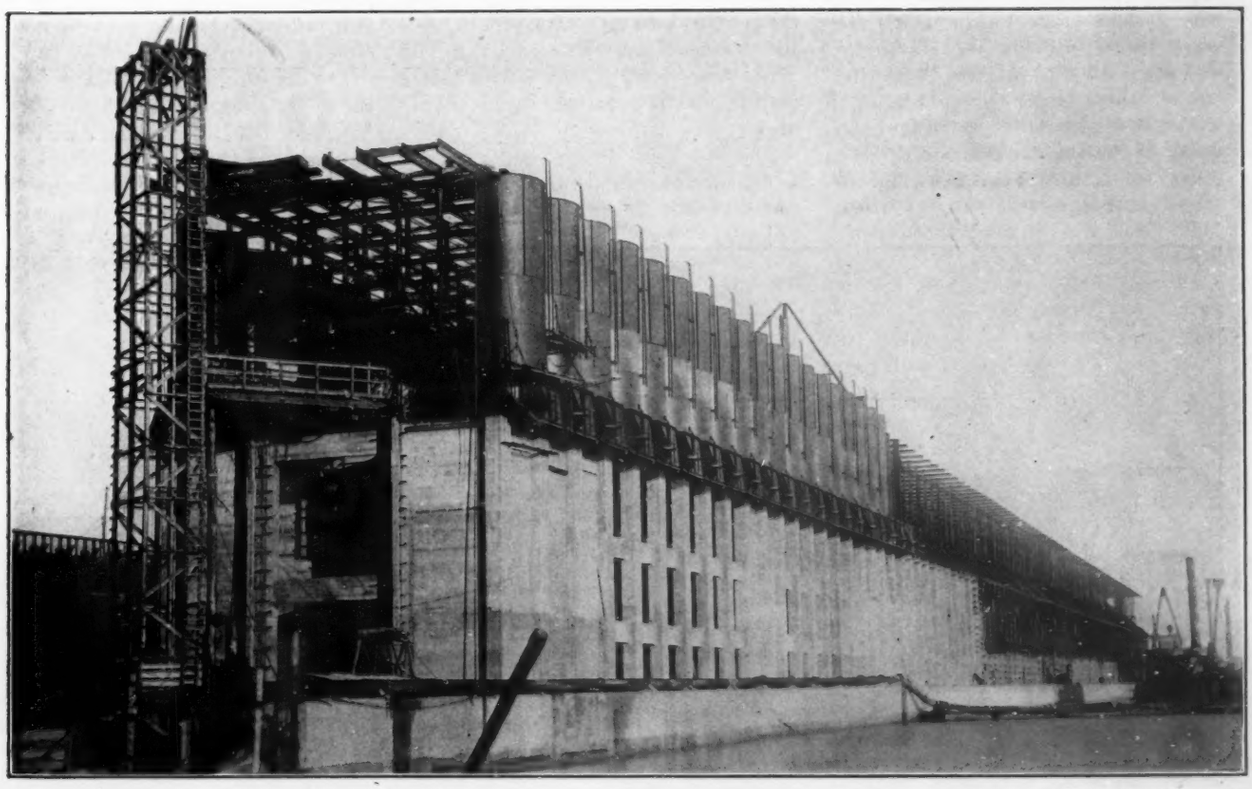


FIG. 1—THE LAKE SUPERIOR & ISHPEMING RAILWAY CO.'S PRESQUE ISLE ORE DOCK, AS IT APPEARED TWO WEEKS AFTER THE CONCRETING OF THE SUPERSTRUCTURE WAS BEGUN

FIG. 2—VIEW OF THE APPROACH TO THE NEW ORE DOCK AT PRESQUE ISLE

spout is 43 feet, so that the ore actually travels down a most precipitous incline. The spouts are 36 feet long, 9 feet wide at top and 4½ feet wide at bottom. The detail of the steel work is well shown at *B*, Fig. 4; *C*, Fig. 4, shows the top of the dock before the deck planking was laid. The skeleton steel work as it appeared on Sept. 9, is illustrated in Fig. 5. The break shown in the concrete fender wall in the foreground was made by the steamer J. G. Butler Jr., which struck the dock head-on while the concrete was still green, going at the time at the rate of seven miles per hour. That work on the dock has progressed with the utmost rapidity is shown in Fig. 1, taken about two weeks later. Fig. 3 shows the appearance of the dock at about the middle of October.

About 14,500 cubic yards of concrete were used in the substructure and 20,000 cubic yards in the superstructure. About 5,000 tons of steel were used in the dock proper and about 1,500 tons in the approach trestle. About 210,000 feet B. M. of maple were used in the pocket lining and 111,200 feet B. M. of fir in the deck.

The old dock at Presque Isle was a difficult one to load at if any sea was prevailing, owing to the fact that it is an open dock, the surge having a tendency to throw the vessel against the dock fender. Frequently, in heavy weather, it was necessary to stop loading and put the ship on the bottom in order to save her from punishment. The new dock being inclosed, no difficulty will be experienced from this source, except that a surge will still prevail when the wind is blowing from northwest to east.

The location of this dock is one of the most beautiful on the lakes, being practically situated in a park. Fig. 2 shows the approach to the new dock, but does not illustrate this phase of the location, as the park lies

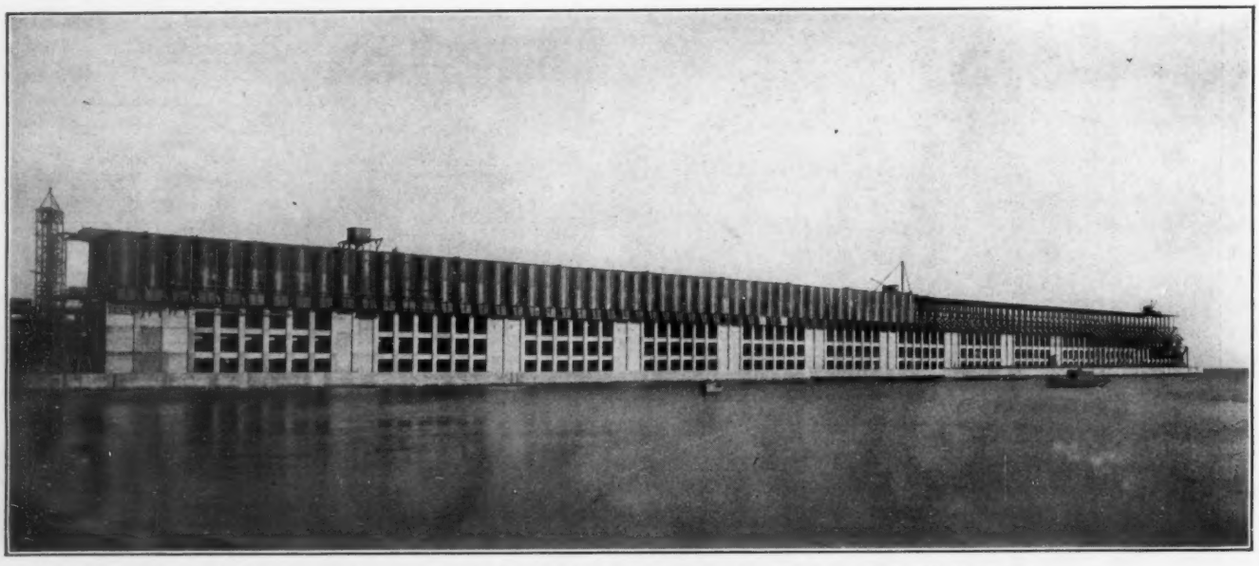


FIG. 3—THE NEW PRESQUE ISLE ORE DOCK AS IT LOOKED ON OCT. 18, 1911

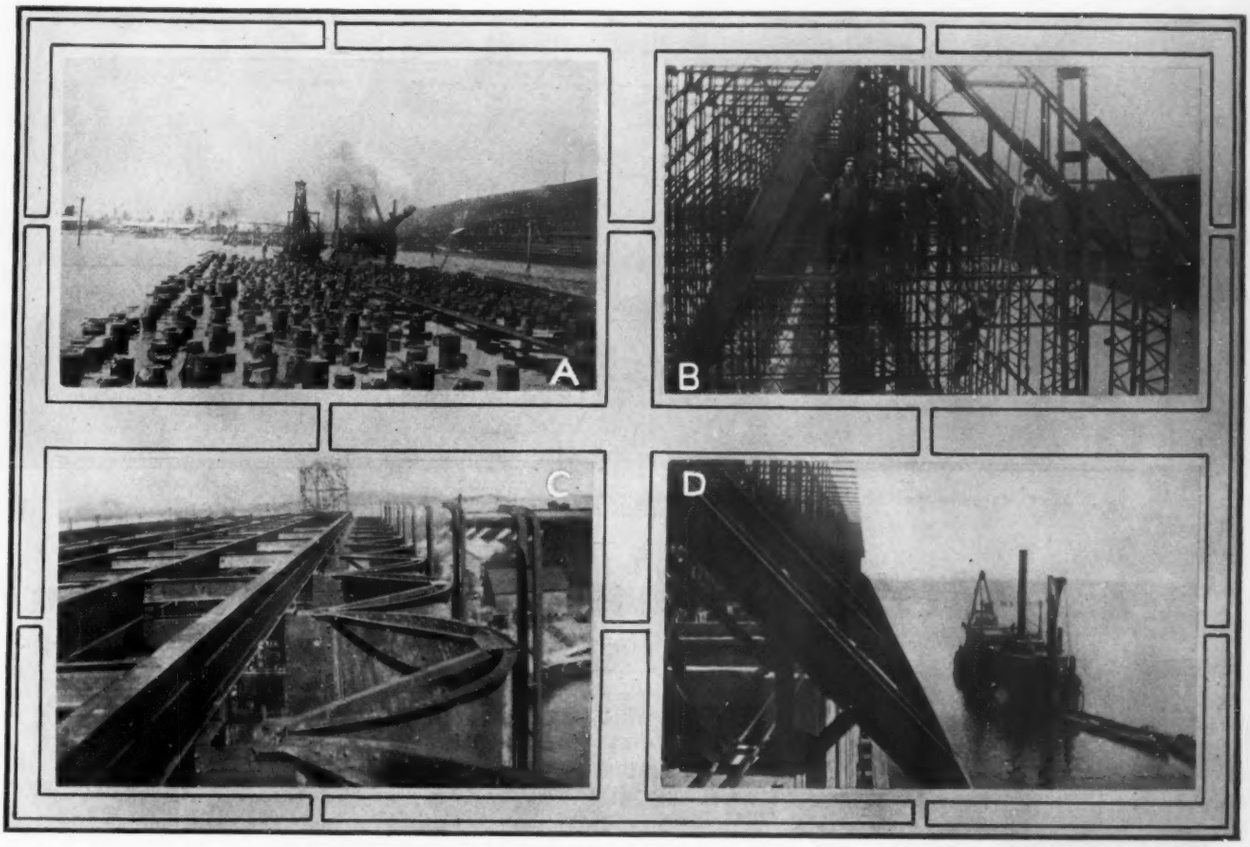


FIG. 4—*A*, WOODEN PILING FOR FOUNDATION OF ORE DOCK; *B*, DETAIL OF STEEL REINFORCEMENT; *C*, TOP OF DOCK, BEFORE LAYING PLANKING; *D*, SIDE VIEW OF DOCK, SHOWING SLANT OF ORE POCKETS

at the other side of the approach.

The engineers in charge for the contractors were W. V. McMerriman, for the Raymond Concrete Pile Co., and J. W. Marlborough, for the Wisconsin Bridge & Iron Co., R. C. Young representing the Lake Superior & Ishpeming Railway Co. as its chief engineer in the construction of the dock.

The total iron ore production of Greece, according to the official statistics for 1910, amounted to 608,000 tons. Of this amount 174,000 tons was mined on the island of Seriphos and the ore contained 51 per cent of iron. Of manganiferrous ore the output amounted to 35,600 tons. The production of iron pyrites was 27,560 tons, which contained 44 per cent sulphur, while mixed sulphur ores amounted to 51,530 tons; 7,000 tons of chrome ore also were mined in Thessaly.

Ventilating Turbo-Generators

With large alternating current turbo generators it is now common practice to clean and scrub the air before it is introduced to the machine, says *The Engineer*, London. With direct current machines these precautions are not so necessary because of the lower generating voltage, but it is not advisable to use the engine room atmosphere for ventilating purposes, as it contains steam and oil in suspension. It is now usual to find dust screens fitted in the air ducts to turbo generators. Although these are, to a certain extent, expensive and troublesome, they are perhaps the simplest and cheapest means of keeping the machine clean. It has been suggested to make the machines simply totally enclosed, and to cool them either with a water jacket or with a carbon dioxide or ammonia freezing plant. These schemes are more complicated and costly, as a rule, than any dust screen would be.

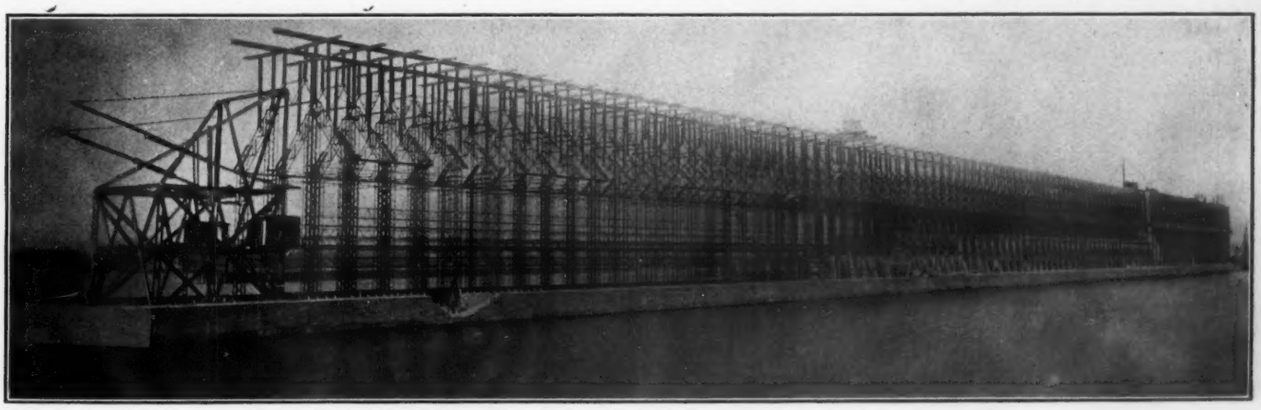
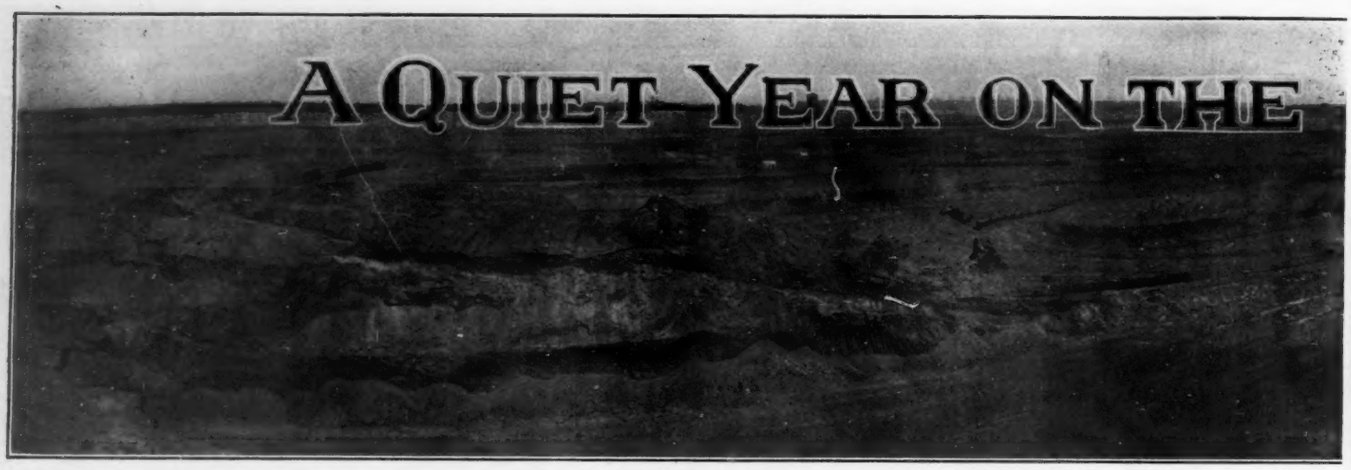


FIG. 5—SKELETON STEEL WORK AS IT APPEARED SEPT. 27, 1911



The Mahoning and Hull-Rust mines at Hibbing; combined, these mines form the greatest iron ore property in the world. The 497,490 tons in 1911. In this mine there now lies one of the largest uncovered bodies

A QUIET YEAR ON THE

A Review of the Season's Developments on

MINING companies operating on the Minnesota iron ranges were not called upon to make any special efforts during the past year and a moderate degree of activity was sufficient to supply all the demands of ore consumers throughout the entire season. Early in the year the prediction was made that shipments during 1911 would not exceed 80 per cent of those in 1910 and upon the close of navigation, November 30, this estimate had been more than fully justified. The rate of production was singularly uniform throughout the season, there being neither the drastic slowing down nor rapid acceleration of activity that have frequently characterized ore operations in the past.

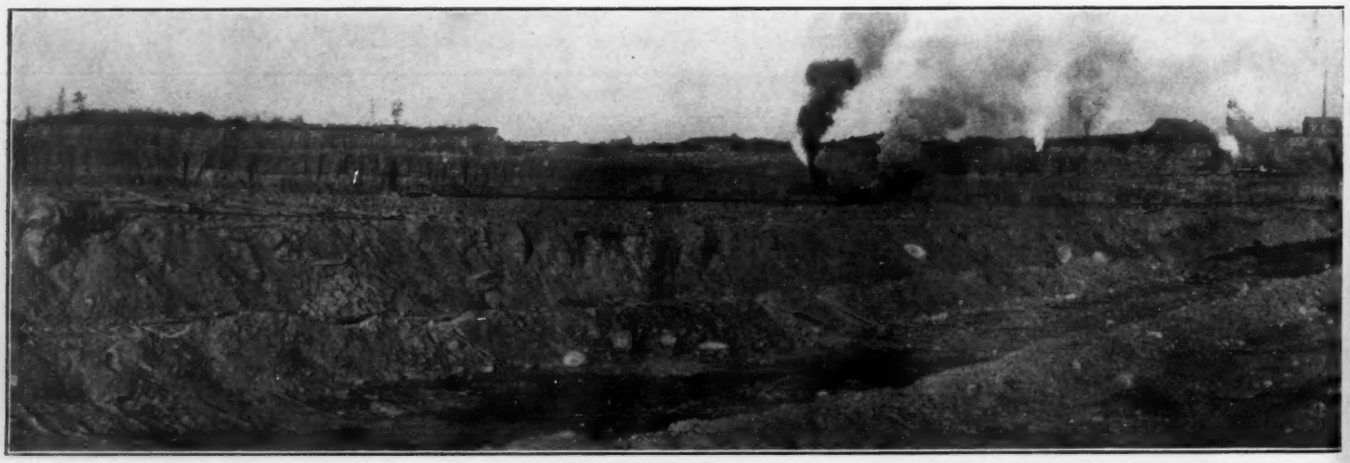
During the season of 1911 the mines on the Mesabi range shipped approximately 21,000,000 tons of ore, compared with 29,201,760 tons handled in 1910 and 28,176,281 tons in 1909. It will thus be noted that operations during the past year were at the rate of 75 per cent of the average output for the two preceding seasons. The Vermillion range made a better showing, but the tonnage shipped from this district is not sufficient to have any radical effect on the total movement from the head of the lakes.

Cuyuna Range Shipments

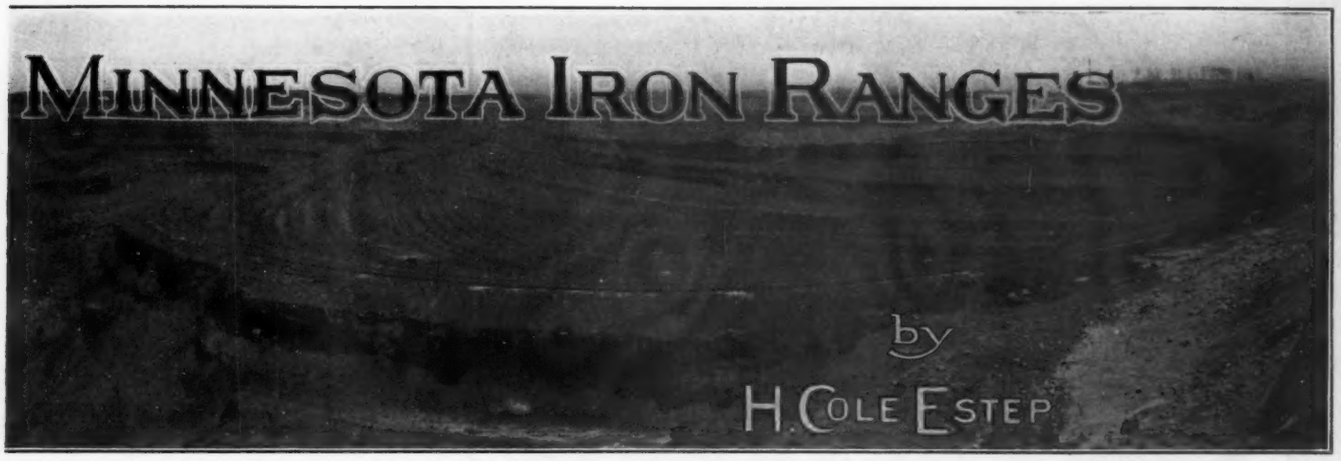
The figures show 1,106,380 tons shipped from the Vermillion range in 1911 compared with 1,203,177 in 1910.

The season just closed witnessed the first shipments from the new Cuyuna range, handled over the Soo dock at Superior, amounting to 147,593 tons. All of this ore came from the Kennedy mine of the Rogers-Brown Ore Co. The total amount of ore shipped by all Minnesota mines during 1911 aggregates 22,254,000 tons, which is 6,947,000 tons less than the 1910 shipments from the Mesabi range alone. The foregoing figures indicate the moderate character of mining activities during the past season, but show that the iron ranges, in spite of slow trade conditions, were reasonably busy. Although the season was comparatively quiet, conditions were, nevertheless, far better than had been anticipated in many quarters and are not comparable to the stagnant situation existing in 1908.

In the latter part of October, practically at the close of the season, two extremely important announcements were made public, which are destined to have an extraordinary influence on the future trend of events on the Minnesota iron ranges. Reference is made, of course, to the cancellation



THE HILL MINE NEAR COLERAINE. THIS IS ONE OF THE FEW PROPERTIES GREAT NORTHERN AND IS OPERATED



Mahoning mine is on the left and the Hull-Rust on the right. In 1910 the Hull-Rust mine shipped 3,189,975 tons against only of iron ore in the world. During the past season the Mahoning mine shipped 1,220,000 tons

the Mesabi, Vermillion and Cuyuna Ranges

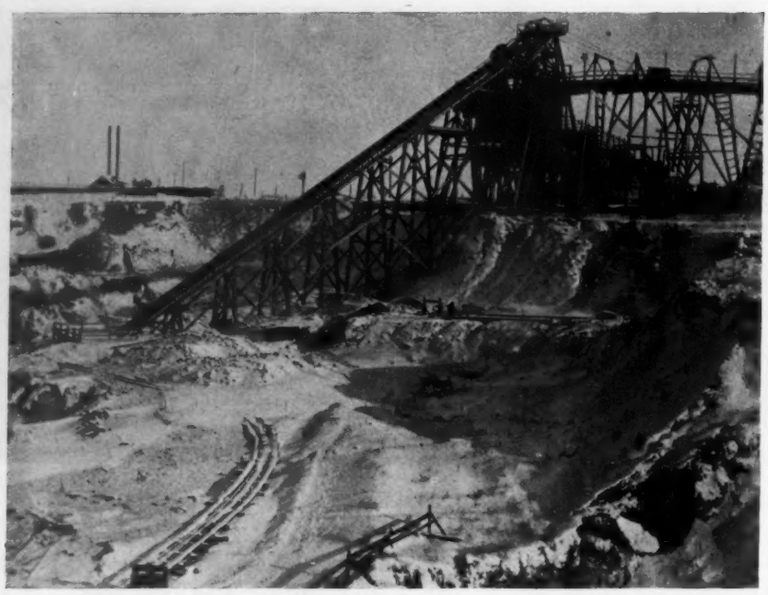
of the Great Northern ore lease and the reduction in freight rates by the ore-carrying railroads reaching the Mesabi and Vermillion ranges. These factors seem to be of equal importance.

The ore lease was executed in October, 1906, between the Great Western Mining Co., a subsidiary of the United States Steel Corporation, and three trustees representing the stockholders of the Great Northern railroad. It embraces 39,296 acres of iron lands situated at various points on the Mesabi range, including several extremely valuable and well-developed mines, as well as a large amount of undrilled, unexplored property. The Steel Corporation estimates the quantity of good ore in the lands defined by the lease to be in the neighborhood of 300,000,000 tons. The terms of the lease provide that the royalty shall be 85 cents a ton for all ore mined in 1907, increasing each year by 3.4 cents. A minimum of 750,000 tons was to be mined in 1907, increased annually by 750,000 tons, until 8,250,000 should be reached in 1917, after which year the minimum was to remain unchanged until the exhaustion of the deposits. The lease contained a clause stating that it could be abrogated by the Steel Corporation on Jan. 1, 1915, formal notice having been given two years previously. It is now the intention of the Corporation to take advantage of this condition and cancel the contract.

Great Northern Ore Shipments

The decision to annul the Great Northern lease was reached by the executives of the Steel Corporation several months before the formal announcement in October and the Oliver Iron Mining Co. conducted its operations during 1911 with this end in view. Shipments of Great Northern ore during the past season were largely increased and arrangements are being made for further actvity in this direction. As a result, although total Mesabi shipments last year were some 8,000,000 tons less than in 1910, certain districts, notably Coleraine, containing a number of active Great Northern mines, shipped considerable more ore than during the preceding season, the curtailment in other territories being correspondingly more severe. The details of this phase of the question will be given in the review of events in the various mining districts which is to follow. It is evident that the Corporation does not intend to permit the rapidly increasing minimum tonnage stipulated by the lease to have the effect of a penalty. On the contrary, its policy, evidently, will be to move as much Great Northern ore as possible during the remaining three years of the contract, at the same

WHICH INCREASED ITS SHIPMENTS DURING 1911. IT IS LEASED FROM THE BY THE OLIVER MINING CO.



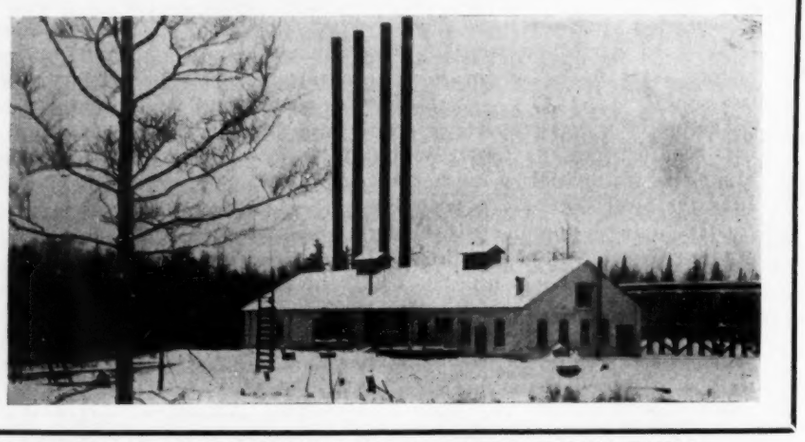
INCLINE INTO PIT AT THE NORMAN MINE NEAR VIRGINIA

time conserving its own mines. If the next three years can be judged by the past season, the Corporation intends to only do enough work on its own properties in the Mesabi district to maintain its mining organization and be prepared for any unusual demand for ore.

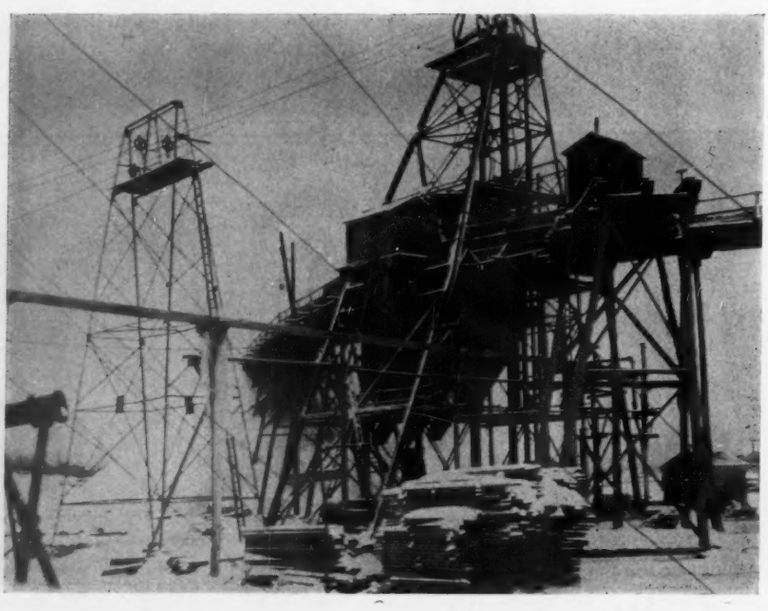
Disposition of Hill Properties

The relinquishment of the Hill properties by the Steel Corporation has resulted in a great deal of speculation as to the ultimate disposition of these lands. As yet the Great Northern trustees have given out no information regarding their plans and it is not likely that the matter will be seriously considered for some time. Nevertheless, the question is one of great interest to the independent operators on the Mesabi range. The trustees have three courses of action open to them: They may organize an operating company to mine the ore and sell it on the open market; they may lease the entire acreage again to some large interest, or they may split up the properties and lease them to a number of separate, independent mine operators. At present sentiment on the ranges seems to favor the latter course as the most feasible and practical. It also has been hinted that the Steel Corporation might be induced to again take over all or a part of the properties under more favorable terms, but this theory of the disposition of the matter is not very seriously considered at present.

The reduced rates on iron ore, which are now in effect, were not applicable to shipments during the past season, but will have an important bearing on operations during the coming year. The new rates are effective on all ore handled by the Duluth, Missabe & Northern and Duluth & Iron Range railroads, subsidiaries of the Steel Corporation, between points on the Mesabi and Vermillion ranges and the docks at Two Harbors and Duluth. The reduction is not only a sweeping one, from 80 cents to 60 cents a ton, but the new tariff names a flat rate from all points. Up to this time the rate has been 80 cents a gross ton from all Mesabi range points, but from Tower on the Vermillion range the rate has been 90 cents to Two Harbors, and from Ely, on the same range, it has been $1. The reduction from Ely will, therefore, amount to 40 per cent, from Tower 33 1-3 per cent, and from all Mesabi range points, 25 per cent.



A TYPICAL, MODERN ENGINE HOUSE ON THE CUYUNA RANGE



HEADFRAME OF THE KENNEDY MINE ON THE CUYUNA RANGE

This change in the iron ore tariff raises a couple of interesting questions which may be briefly stated as follows:

Will the benefit of the cut rates

accrue to the mining companies or will the consumers force a lowering of ore prices by an amount equal to or exceeding the reduction in freight?

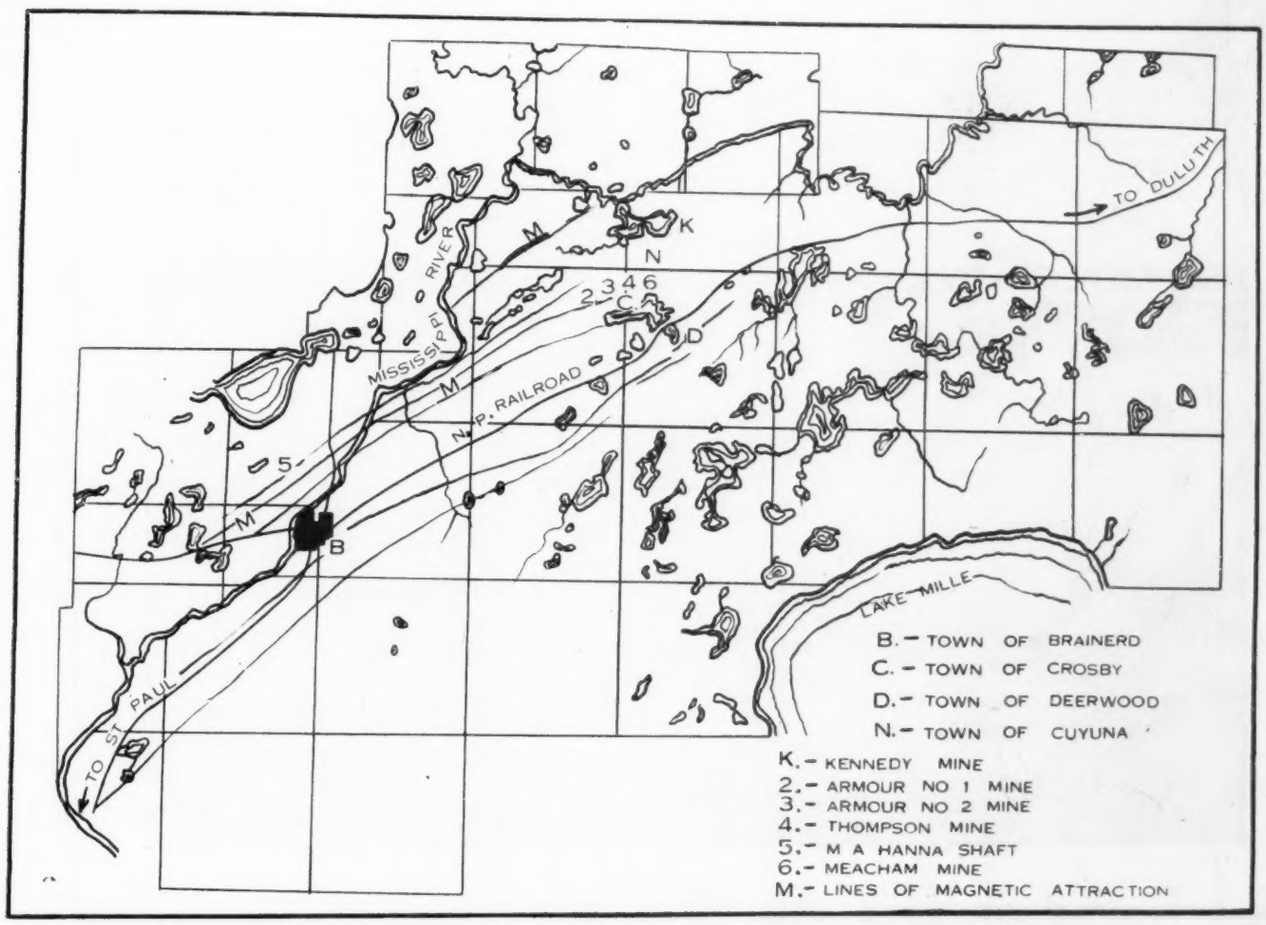
What effect will the new rates have on the competition existing between new and old range ores?

Taking up these questions in reverse order, there seems little doubt but that the new rates will further stimulate the development of the Minnesota ore properties at the expense, possibly, of mining on the old ranges. Individuals interested in both districts concede this point. The enormous mines on the Mesabi range have been sufficient to take care of the situation. As a matter of fact, the condition of the steel trade next spring will undoubtedly be the determining factor in the problem. If business is good, the mine operators will probably be able to maintain the present ore quotations and absorb the benefit of the reduced freight rates. On the other hand, if the trade remains slow with no special demand for ore, it is extremely doubtful if present prices will be adhered to in face of the lower carrying charges.

At the present time Mesabi Bessemer ore with a guarantee of 55 per cent iron is quoted at $4.25 per ton and Mesabi non-Bessemer, guaranteed 51½ per cent, is held at $3.50, delivered at Lake Erie ports. These prices were fixed in the middle of April, 1911, co-incident with the commencement of shipments, and represent a reduction of 50 cents a ton under previous quotations in effect during the season of 1910. The lower ore prices were forced by the decline in pig iron and the generally unsatisfactory condition of the iron trade.

Early in May the lake freight rate from Duluth was fixed at 60 cents, which is a cut of 10 cents from the 1910 rate. The rates from Marquette and Escanaba were reduced to 55 cents and 45 cents, respectively. In effect the rates were the same as in 1908 and 1909, the unloading charge having been reduced five cents in 1910. Some effort was made to hold the rate at 65 cents, but there was so much tonnage on the market at the opening of navigation that it could not be held at that figure.

Before plunging into the details of the season's activities on the Mesabi and Vermillion ranges, it will be interesting to review the events in



MAP OF THE CUYUNA IRON RANGE IN AITKEN AND CROW WING COUNTIES, MINNESOTA

developed in the face of comparatively unfavorable freight charges, and any reductions that bring the old and new districts to a more nearly equal footing in this respect, are sure to stimulate further activity on the Minnesota properties.

There is a wide difference of opinion among ore men as to future course of prices due to the recent changes in freight rates. Some are convinced the consumer will reap all the benefit and leave the miner even worse off than before; others contend that the reduction of 50 cents a ton effected during the past season was

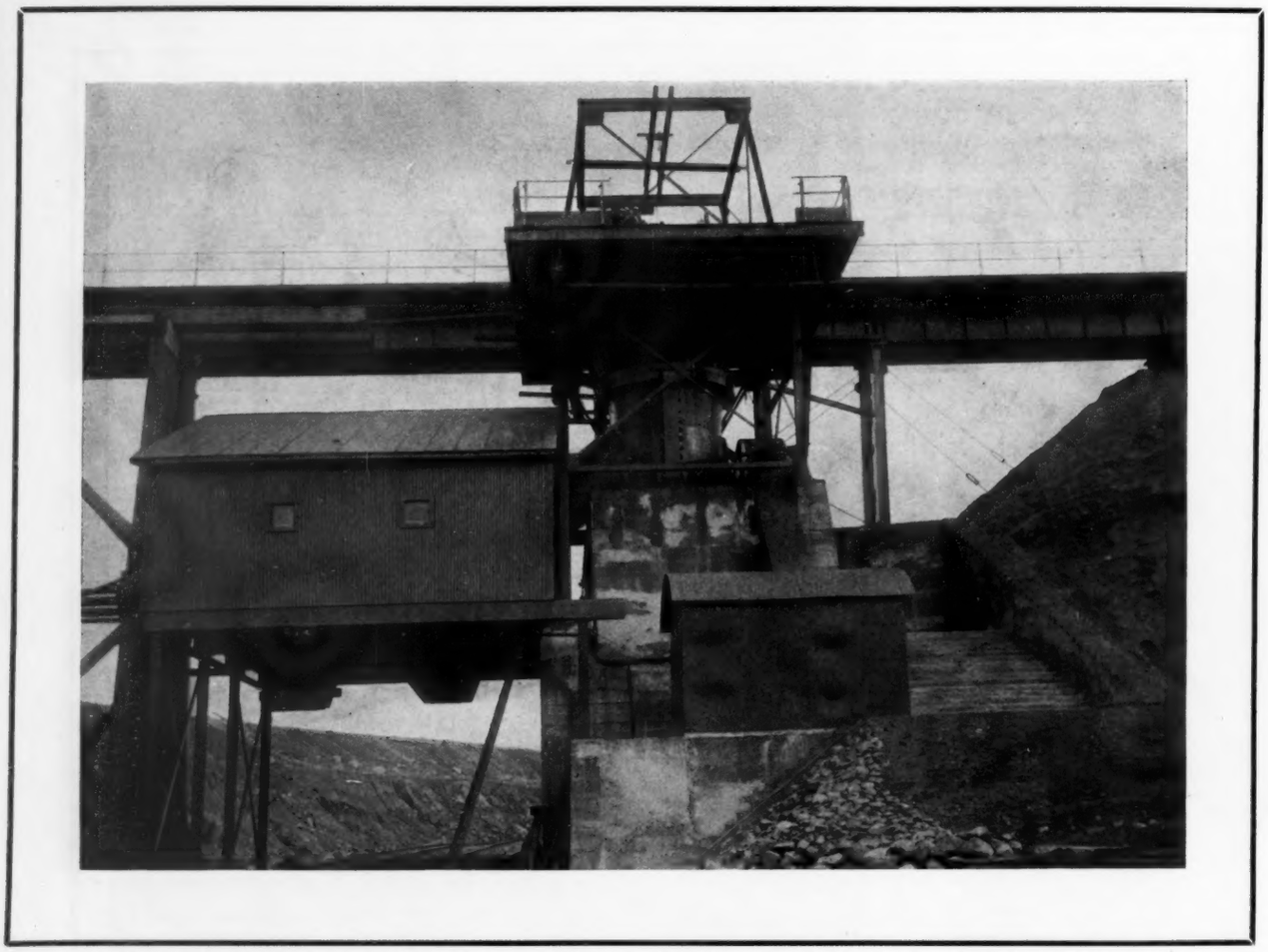
the Cuyuna district. This new range shipped its first ore in 1911, and may now be said to be fairly established as one of the important iron mining centers of the country.

The Cuyuna range covers a territory about 10 miles in length and three miles in width in Aitken and Crow Wing counties, Minnesota. The main axis of the range extends from the south shore of Rabbit lake in Township 47 north, Range 28 west, in a general southwesterly direction, to a point west of Brainerd, in Township 45 north, Range 31 west. Most of the mining activity up to the

present time has been confined to the eastern end of the range in the vicinity of Rabbit and Serpent lakes. In a general way, the range lies parallel to the Mississippi river and is about 100 miles southwest of Duluth. It is reached at present by the Minneapolis, St. Paul & Sault Ste. Marie and the Northern Pacific railways. The ore deposits on what is known as north range vary in quantity from 1,000,000 up to 10,000,000 or 12,000,000 tons per 40 acres and the ore varies in grade from a low grade non-Bessemer to a high-grade Bessemer hematite. There are some drill holes that will average 65 per cent iron for a depth of 150 feet. The ore is found directly under the glacial drift, dipping at an angle of from 45 to 80 degrees southeast. The original footwall rock appears to be amphibole magnetite slate and is variegated with light and dark-colored seams. This is true of the north deposit at the Kennedy mine, which is the most highly developed property on the range. The hanging wall is a green and red schistose slate. Some drill holes have been put down on the north range to a depth of 985 feet and stopped in 48 per cent iron ore, although these are, of course, exceptional. The overburden varies from 22 to 300 feet. The average depth of the overburden from Rabbit lake to Brainerd is in the neighborhood of 60 feet. Nevertheless, the nature of the deposits is such that it has not been found expedient to mine by open-pit methods. This is due in part to the folded and faulted nature of the formations. The range has been the scene of active mining development for the past two years and a large number of ore leases have been executed. The royalties on these leases vary from 10 cents per ton, on a minimum of 10,000 tons per year, up to 65 cents on a similar minimum.

The United States Steel Corporation has no properties on the range. The ore bodies are being developed principally by the Rogers-Brown Ore Co., the Inland Steel Co., of Chicago, and interests affiliated with M. A. Hanna & Co., Cleveland. The Rogers-Brown Ore Co. has been the most active of the three and now owns four concrete shafts, one of which is shipping ore,, while two of the others are nearly at the shipping stage.

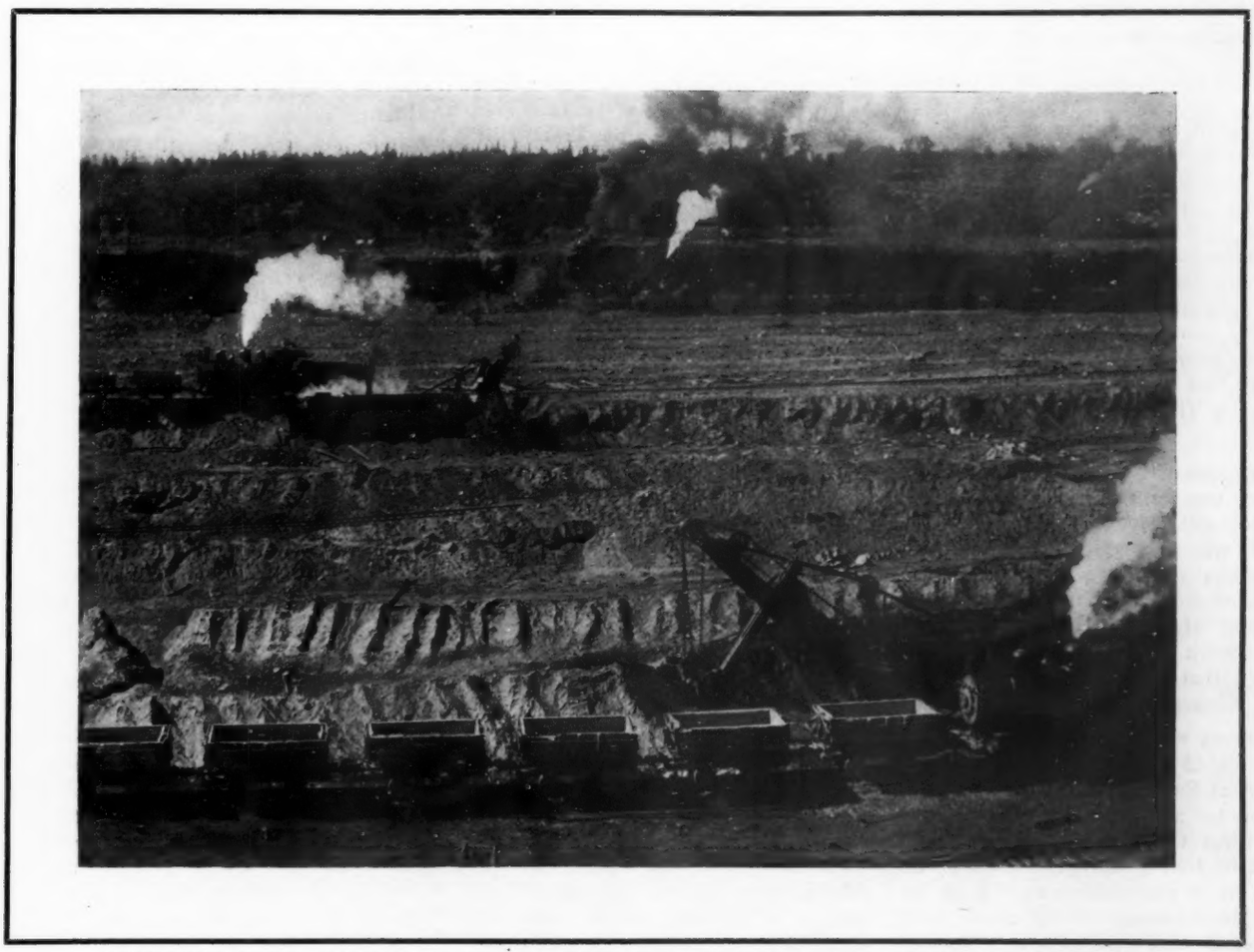
The most highly developed property on the range is the Kennedy mine, situated on the shore of Rabbit lake, near the town of Cuyuna. This is one of the Rogers-Brown properties. It contains a new shaft which was completed Feb. 7, 1910, after five months actual work in sinking. The shaft has reached a depth of 262 feet and is 10 x 14 feet in size, inside. The ore body had been well developed and during the past season the first shipments were made from this property, totaling 147,593 tons. The mine will be operated all winter and is now producing ore at the rate of 225,000 tons a year. A drift, 1,000 feet long, has been recently completed for the purpose of developing what is known as the north ore body, which is one of the largest deposits in the property connected with the mine. The final work on this haulage drift will be finished this winter and the ore will be developed so that it will be possible to ship from this deposit



ORE CRUSHER AT THE BIWABIC MINE, WHICH IS ONE OF THE LARGEST EVER BUILT; IT HAS A CAPACITY OF 1,000 TONS PER HOUR

early in the spring. Drillings in this body show an average of from 58 to 64 per cent iron. There is only a comparatively small amount of ore in stock at the Kennedy mine at present, but it is expected that shipments next season, if the mine is worked to its capacity, will reach 250,000 tons. The mine has been very completely equipped with modern machinery, including a 100-foot steel head frame and the shaft has a hoisting capacity of 500,000 tons a year. Three-ton skips are used.

At a point about a half mile north-



STRIPPING AT THE HOLMAN MINE NEAR COLERAINE. THIS IS ONE OF THE GREAT NORTHERN PROPERTIES

east of the town of Crosby, the Rogers-Brown Ore Co. has recently completed two new concrete shafts which are known respectively as Armour No. 1 and No. 2. The shaft at Armour No. 1 was finished in September, 1911, after reaching a depth of 330 feet. Two levels have been started, one at the 200 and the other at the 300-foot depth, and are now well under way. Pump stations cut out of the solid rock have been established on the lower levels. This mine is also equipped with a 100-foot steel headframe and the shaft is provided with 4-ton skips.

Work on sinking the shaft at the Armour No. 2 property was started July 17, 1911, and reached a depth of 200 feet on Nov. 17. The first 75 feet of the shaft is concrete. At the level now reached drifts have been started to tap the north and south ore bodies, which are 400 and 265 feet from the shaft, respectively. A pump house has also been recently completed at the bottom of the shaft and foundations installed for a 2,000-gallon Prescott, cross-compound pump. This property gives promise of being an exceptionally successful mine, containing high grade ore which can be easily and economically brought to the surface. Several drill holes in the property, 400 feet deep, show an average of 65.5 per cent iron with the phosphorus running from 0.04 to 0.07 per cent and manganese averaging 0.05 per cent. The ore body tapped by these drillings is 280 feet in thickness, 75 feet of which is of Bessemer grade. Another drill hole on this property shows 66 per cent iron and phosphorus, 0.07 per cent. An automatic Sullivan skip hoist with Meyer cut-off has been installed at this mine and also a 12,000-pound Sullivan cage hoist. Steam is generated in four 150-horsepower, 72-inch x 18-foot tubular boilers, equipped with Burke furnaces. The boilers are fitted with superheaters which deliver the steam at 150 pounds pressure, with a superheat of 450 degrees. The buildings are brick and steel construction absolutely fireproof and the company carries its own insurance. All the buildings are equipped with cement tile roofs and the engine house floors are of reinforced concrete.

In addition to the foregoing properties which are being actively developed, the Rogers-Brown Ore Co sunk the Meacham shaft in 1910 at a point about a half mile east of the Armour shafts. This shaft, which is concrete, has reached a depth of 220 feet. At the present time no further work is being done on the property.

The Inland Steel Co. is now engaged in actively sinking what is known as the Thompson shaft on a

120-acre tract which it has acquired north of the town of Crosby. The shaft is concrete for the first 85 feet. The work of sinking it was commenced late in June, 1911, and it has now reached a depth of 225 feet and will be continued to about 260 feet. The shaft is 10 feet, 10 inches x 14 feet, 10 inches, inside. It has been sunk for the purpose of tapping two ore bodies which lie to the east and west, respectively. In spite of considerable difficulty with water, the work of sinking the shaft has continued without delay and in the meantime the necessary equipment has been installed on the surface, including hoisting apparatus, boilers, etc.

New Shaft Near Gilbert Lake

In addition to the foregoing, M. A. Hanna & Co. are sinking a shaft on an extensive deposit situated near Gilbert lake, west of Brainerd and about nine miles from the other developments on the range. This shaft has reached a depth of 75 feet and a drop shaft started. It may be said, in this connection, that all six of the shafts now existing on the Cuyuna range are concrete-lined and were sunk by The Foundation Co., of New York.

The season of 1911 was a very active one on the Cuyuna range and a great deal of extensive development work was accomplished. In addition to the shaft-sinking and mining operations mentioned, there was a large amount of prospecting and exploratory work accomplished. It is estimated that 100 drills were in operation during the season.

Cuyuna range points have a freight rate of 65 cents a ton to the Soo docks at Superior, with a further provision for a 60 per cent rate effective any time the total shipments exceed 2,000,000 tons annually. However, on account of the reduction in rates on the Mesabi range to 60 cents, it is expected that the Cuyuna district will be favored by a similar rate next season in order that there may be no differential operating against it. The Cuyuna range expects to very largely increase its shipments next year and it is now hoped that at least three mines will be delivering ore.

The western Mesabi range in the vicinity of Coleraine, Marble and Taconite, was a center of great interest during the past season, on account of the large mines in this district operated by the United States Steel Corporation under lease from the Great Northern railway. Due to these mines, the Coleraine district was the only one to show an increase in ore shipments during the past season compared with 1910. There are three large mines in the district, namely the Hill, Holman and Canisteo, with which is consolidated the Walker. The Hill, Holman and Walker mines are Great Northern properties and were very active during the season. Shipments from these mines were as follows:

	Tons.
Hill	1,553,000
Canisteo, Walker	1,342,000
Holman	780,000
Total	3,675,000

This is about 1,500,000 tons in excess of 1910 shipments and while this activity may be attributed largely to the Corporation's desire to fulfill its obligations under the Great Northern lease, it is also due to the fact that the large concentrator on Trout lake was in a position to operate during the past season at its utmost capacity, thereby making it possible to handle the sandy ores which predominate in this region.

These ores are a mechanical mixture of hematite and sand, or of hematite and a highly silicious shale or paint rock which runs low in iron and high in silica. Some of the ore carries a fairly high percentage of iron but the silica content is too great to class it as a desirable shipping ore. This difficulty is sometimes overcome by mixing with high grade ore low in silica, thus giving the desired average silica content to the mixture. But it is not always convenient to make the proper mixture and occasionally the silica is too high for such a method, especially at the western end of the range. Concentrating plants are, therefore, necessary.

Sandy Ore

This sandy ore first becomes noticeable in considerable quantities just west of Nashwauk and is found at intervals from that point to Coleraine, the western limit of operations at present. Exploratory work has been done as far west as Grand Rapids and even beyond, and while some of the drill holes show a favorable indication of an extension of the ore bodies, no actual development work has been yet attempted west of Coleraine. All of the active mines in the district mentioned, including the North Star, which is virtually a part of the Holman property, contain more or less of these sandy ores.

Experiments in washing the ore were begun by the Oliver Iron Mining Co., in 1907, and resulted so satisfactorily that a large washing plant was started a year or two later to treat the lean ores. The plant is divided into five units, each with a capacity of 100 tons of crude ore per hour, giving a total of 10,000 tons per day of 20 hours. Provision is also made for the construction of seven additional units which would give the plant a capacity of about 25,000 tons a day. The fifth unit was completed early in 1911. The details of this plant were fully described and illustrated in THE IRON TRADE REVIEW, Jan. 19, 1911.

Output of Washing Plant

With five units operating, the plant delivered 1,976,000 tons of concentrated ore during the season of 1911 between April 24 and Oct. 28. This involved the handling of approximately 3,000,000 tons of raw ore and it is thus seen that 81 per cent of the ores mined in the district during the season were treated at the washing plant. The activity in this respect can be better appreciated by comparing the output in 1910, when only 600,000 tons of concentrated ore were shipped. The extremely variable nature of the ore, even in a single trainload, makes it difficult to obtain actual figures regarding the saving effected by the washing process and the ratio of concentration. In general, it may be stated, that the ore treated will run from 35 to 48 per cent iron, with some of the higher grade containing an excess of silicon, and the washed product averages 56 to 60 per cent iron. There is, of course, some unavoidable loss from ore being carried away by the waste water, which runs as high as 1.8 per cent iron. Much of this, however, may be from the pulverized paint rock which is carried away and this could not be saved. The water in the tail race runs high in silicon. The washing plant at Coleraine has met with such success that the International Harvester Co. is now constructing another plant of similar character on the shores of O'Brien lake, near Nashwauk, about 15 miles northeast of Coleraine.

The mines in the Coleraine or Canisteo district, as it is more commonly called, are all open pits and are now well-developed, as indicated by the production figures given. The unusually extensive stripping operations which have characterized this district in the past gave way to actual mining during the past season. Stripping in the Hill mine, which was started in August, 1908, was discontinued in September, 1911. A moderate amount of stripping will be

done this winter in order to uncover additional ore bodies and at the present time three shovels are employed in the Canisteo pit.

Provision for Drainage

The Canisteo pit is now opproximately a half mile long, 1,200 feet wide and 120 feet in depth. Of this depth, about 80 feet represents the overburden. On account of the nature of the soil it is necessary to make suitable provision for draining the pits in this district. In order to take care of the water, shafts are sunk at the sides of the pits and drifts are extended longitudinally underneath, with suitable cross-cuts at intervals, which, together with raises reaching the surface, form a system for collecting and disposing of the water. In this respect the open pit mining in the Canisteo district differs from that at other points on the Mesabi range, where the water problem is not so serious. The Walker pit, which lies adjacent to the Canisteo, is now a half mile long and approximately 700 feet in width. The Hill pit is about 2,600 feet in length and 700 feet in width, while the Holman mine is 1,400 feet long, 1,200 feet wide and 55 feet deep. The overburden at this mine averaged from 40 to 70 feet in thickness.

Little Activity at Nashwauk

With the exception of the International Harvester property, there was comparatively little activity among the mines in the vicinity of Nashwauk. The Harvester company operated its Hawkins mine, which is an open pit, and shipped 240,088 tons. A couple of steam shovels will be engaged during the winter stripping on this property. The pit now sweeps in a large crescent, 3,000 feet long and approximately 800 feet wide. It lies north of the village with its concave side facing the south.

The International Harvester Co. is now building a concentrating plant on the shores of O'Brien Lake, about 2½ miles southwest of the Hawkins mine. This plant will be similar in its general construction to the Oliver Iron Mining Co.'s plant at Coleraine. Only one unit is being constructed at present, which will provide capacity for treating 2,000 tons of crude ore per day. It is thus seen that the plant is one-fifth of the size of the one at Coleraine. It is expected to have the unit ready for operation in the early spring. The building is 80 x 80 feet in size and the apparatus is arranged similarly to that in the Coleraine plant, except that there are no overhead storage bins. Track bins are provided instead, with a belt conveyor leading to the conical screen. The power house and pumping station is located on the shore of the lake. It is 60 x 72 feet in size with a coal dock in the rear, 100 x 40 feet. This plant is 2,000 feet from the concentrator and the water for washing the ore will be pumped this distance through a 16-inch pipe. A storage tank with a capacity of 22,000 gallons is being installed. The Great Northern will build a spur, two miles in length, to connect with the concentrator this winter. Forty new steel, 40-ton ore cars have been ordered for hauling ore between the pit and the washing plant.

Season's Shipments

The Crosby mine at Nashwauk, which is a combined underground and open-pit property, controlled by the Cleveland-Cliffs Iron Co., was idle during 1911. A part of this mine was stripped in 1910. The La Rue mine, nearby, controlled by M. A. Hanna & Co., shipped 30,000 tons during the past season. No stripping operations were conducted. The Pearson mine, in which Col. Joseph Sellwood, of Duluth, is interested, was operated, and shipped 76,000 tons. The Roberts mine, a new independent property, has not yet been stripped, but a spur was built to it and some work on the property will probably be done next year. A new underground mine, known as the Platt, was opened at Nashwauk during the season and produced a small quantity of ore. It is a comparatively small property controlled by independent interests and is located about a half mile north of the Crosby property. The St. Paul mine at Kewatin, controlled by Corrigan, McKinney & Co., Cleveland, did not ship any ore, but conducted, extensive stripping operations. The Mississippi mine in the same territory, which is one of the Great Northern properties operated by the Oliver Iron Mining Co., was active and shipped about 40,000 tons per month.

The assessed valuations of mining properties in Itasca county, Minnesota, which includes the Canisteo and Nashwauk districts, were increased $2,000,000 during the past year and are now listed at $25,500,000. The largest single assessment raised was that of the Canisteo mine at Coleraine, which was increased from $944,385 to $1,669,770. The assessment on the Holman property was increased from $406,373 to $716,216. At Nashwauk the assessment on the Hawkins mine was reduced from $807,618 to $776,574, while that on the La Rue property was cut from $580,762 to $255,344.

Much Ore Exposed at Hibbing

Contrasted with previous years, the past season was a very quiet one in the Hibbing district and compared with 1910, shipments show a shrinkage of approximately 50 per cent. The little actual mining done permitted the management of the various properties to proceed with stripping and development work without interruption and there was a moderate degree of activity in this direction. As a result of this work coupled with the efforts of previous years there are now uncovered and awaiting shipment in the Hibbing district some of the largest deposits of iron ore in the world. In the Hull-Rust pit for instance the stripping operations of the past season and the one preceding have uncovered a clean, level ore body a mile in length and one-third of a mile in width. Other mines are similarly developed. In the case of a sudden increase in the demand for ore, the Hibbing district, by virtue of these preparations, is in a position to make unprecedented shipments. Never before in the history of the district have there been such large bodies of ore lying uncovered ready for loading.

Hibbing Ore Shipments

As usual, the Oliver Iror. Mining Co. was the heaviest shipper in the Hibbing territory. During the season it forwarded 3,220,000 tons of ore and the extent of the curtailment may be appreciated when a comparison is made with the 1910 shipments, which were slightly in excess of 7,000,000 tons. The greatest reductions in output were from the Corporation's own properties, the Great Northern leased mines being quite active, as in other districts. The Hull-Rust mine, which produced 3,189,975 tons in 1910, shipped only 497,490 during the past season; the Sellers pit, with a 1910 record of 954,042 tons, shipped approximately 87,000 tons in 1911, and the Burt forwarded 56,500 tons, compared with 1,032,815 tons in 1910. On the other hand, the Mississippi, Mace and Harold mines, underground, and the Dale and North and South Uno pits, all Great Northern properties, were busy both with actual mining and development work. Their combined 1911 shipments form a large share of the 3,200,000 tons forwarded during the season by the Oliver Iron Mining Co.

In the past two years the stripping

and development work has greatly changed the topography of the pits around Hibbing. The town is now entirely surrounded by mines except on the south. Egress is permitted to the north and northeast by two steel viaducts which have been thrown across each end of the Sellers pit.

Separate Tracks for Ore and Stripping

The Sellers and Hull-Rust pits have each been connected by a deep cut across the north edge of the town, through property formerly occupied by residences, stores and the district headquarters of the Oliver Iron Mining Co. This makes a continuous pit over three miles in length sweeping around the east, north and west sides of Hibbing in the form of a half-moon. The overburden in many places on this work was 80 feet thick. The Burt mine is also now connected with the Sellers, while nearly all the barrier between the Hull-Rust and Mahoning pits has disappeared and the balance is in the process of removal.

In operating these pits, the Oliver Iron Mining Co. has adopted a policy of providing separate approaches for hauling out ore and stripping. The ore from the Sellers and Burt pits passes out through a deep cut north of the town, and traversing parts of the Hull-Rust mine, reaches the new car distribution yards through an approach at the south end of the latter property. Ore from the Hull-Rust pit moves out through the same channel. Stripping from the Sellers and Burt pits is carried to the dump through an approach cut at the east end of the Sellers mine, just east of Hibbing. At the present time work is under way developing a new approach for taking out stripping from the Hull-Rust pit. This is situated at the southwest end of the property and will connect with the spoil banks south and west of the city.

Three shovels will be employed stripping in the Sellers pit this winter. At present two are at work on the east side and one on the west side of the property. In the Hull-Rust pit three shovels are employed also in stripping operations.

Creek Diverted

Due to the work mentioned, Penobscot creek, which naturally flows through properties in a general north and south direction, has been diverted to the west to Carlson lake and drainage ditches have been dug on the east side of the pits, thus cutting off water which approaches from that quarter. The old Penobscot mine has been turned into a pumping well and a new two-compartment, steel-lined shaft is now being sunk on this property in order to more effectively handle the water. This shaft is now 180 feet deep and will be sunk to a depth of approximately 225 feet. It is one of the very few steel-lined shafts on the range. In general, in addition to mining, the work of the Oliver Iron Mining Co. in the Hibbing district during the past season was confined to stripping, developing and exposing ore bodies in the Hull-Rust and Sellers mines and preparing the new approach for the removal of stripping from the Hull-Rust mine.

During the past two seasons the Buffalo and Susquehanna Mining Co. has stripped practically all of the overburden from the Buffalo pit, which lies east of the city and south of the Sellers mine. This property is now in a position to enter the producing class. In order to expose the ore bodies an unusual depth of overburden was removed, in some places amounting to 150 feet and, although the pit is not unusually large, the stripping has amounted to over 6,000,000 cubic yards. Three steam shovels will be kept at work during the winter.

Laura Mine

The Laura mine of the Inland Steel Co., Chicago, which is an underground property northeast of Hibbing, was active during the past year and will be operated throughout the winter. Stock piling was started at this mine on Sept. 15, 238,824 tons having been shipped during the year. By the middle of November there was approximately 40,000 tons of ore in stock on the dump and the mine is operating at a rate of approximately 300,000 tons per year. The Inland Steel Co. has recently acquired control of the Grace mine, at Chisholm, which it is estimated contains about 2,000,000 tons of high grade ore. At the present time there is a shaft on the property but no levels have been established. It is planned to develop the property at an early date.

The Utica mine, controlled by Pickands, Mather & Co., was operated underground during the past season, shipping 91,594 tons of ore. There is also an open pit on this property whch was idle. The same interests control the Scranton mine, an old property that has been re-opened during the past two years. This mine shipped 1,168 tons in 1904 and since that date until recently has not been especially active. The mine is now provided with a shaft reaching a total depth of 241 feet, 152 feet of which is concrete. No ore has yet been shipped, but about 50,000 tons has been mined and placed in stock. The underground workings are now becoming well-developed and the property is in a position to deliver a large output next year. Development work and mining of the usual character was the program of the season on the Hibbing properties of the Shenango Furnace Co.

Growth of Hibbing

The old Mahoning mine, which was the first open pit to be developed in this district, is now opened to a length of 1½ miles and a width of one-half mile. This property, which has always enjoyed a very steady production record, shipped practically its usual quota of ore during 1911, amounting to 1,220,000 tons in round numbers. It is one of the very few mines in the district that has not been subject to violent fluctuations in output during the past four or five seasons.

The mining operations in the vicinity of Hibbing have considerably altered the appearance of the town and necessitated radical changes in the railroad facilities. The Duluth, Missabe & Northern has built a new passenger station and general freight yard south of the city, where a considerable area has been reserved for warehouse and general industrial purposes. On the west side of town the Oliver Iron Mining Co. has built a new coal dock for handling the fuel used in its locomotives and steam shovels. A very extensive new switch yard for classifying cars and making up ore trains has been built by the Duluth, Missabe & Northern on a site south of the city, replacing the old yard which was located to the west at a point now occupied by part of the Hull-Rust pit. The new yard has 20 tracks, each approximately a mile in length, and is especially designed for the rapid handling of ore traffic. The Duluth, Missabe & Northern is also building a distributing yard southeast of the city for the Buffalo and Susquehanna Mining Co., which will be utilized in handling the output of the new Buffalo pit next season.

Shipments from Virginia

The Oliver Iron Mining Co. shipped 1,708,764 tons from the Virginia district during the past season. Of this amount the Sauntry-Alpena group furnished 1,057,839 tons; the Norman mine 644,381 tons, the Missabe Mountain 5,294 tons, and the Higgins No. 2, 250 tons. There are no Great Northern properties active or developed in the Virginia district. As indicated

by the foregoing figures, the principal activity in this territory during the past year was confined to the Norman and Alpena properties. The underground workings in the latter mine have been thoroughly developed and shipments are now made through two shafts. In the Alpena pit, north of the underground portion of the mine, an island of rock about 1,000 feet in length and 125 feet in width has been discovered extending through the center of the pit, dividing the ore body into two parts. There is considerable good ore mixed with the rock. The existence of this island has interfered considerably with the economical operation of the property and steps are now being taken to remove it. Drifts have been cut through every 100 feet on a level with the bottom of the pit and steam shovels will be kept at work during the winter removing the material. All of it, of course, will have to be heavily blasted in order to break it up sufficiently so that it can be handled by a steam shovel, and by what virtually amounts to a hand-picking method, the good ore will be extracted. After the island of rock is removed the Alpena pit will be in excellent shape.

The Norman mine, which is situated on a hill east of Virginia, is also a combined underground and open pit property. In fact this mine represents an open pit working in its last stages. The pit is very deep at the east end, the floor resting on the ceiling of the main underground level. An inclined skip-way has been erected at this property for hauling ore and rock out of the pit. The incline is 550 feet in length with a vertical lift of approximately 375 feet. It consists of two 5-ton skips, operated in balance by a direct-geared steam hoist. The underground portions of the mine are being well developed and the ore is removed by the usual methods, including some large square-sets at the east end. The famous Mountain Iron mine was idle during the past season, which makes the third year since 1908 that no ore has been shipped from this property. During that season only 206,698 tons were forwarded.

The Eveleth District

At Eveleth the big Fayal pit was shut down, but the underground portion of this property was operated. The Adams and Spruce mines were active. Shipments by the Oliver Iron Mining Co. from the Eveleth district were 2,395,000 tons during the season of 1911. The Leonidas shaft has been recently completed after two years' work encountering considerable difficulty from water. At present 3,000 gallons per minute are being pumped from the shaft.

The independent mines in the vicinity of Virginia and Eveleth were generally active during the past year, but the scale of operations in almost every case was curtailed. Corrigan, McKinney & Co. operated the Commodore mine. The Republic Iron & Steel Co.'s Union, Franklin, Bessemer, Victoria and Schley were partially operated and the Lincoln mine of the Interstate Iron & Steel Co. was active. M. A. Hanna & Co. shipped considerable ore from the Silver property, which is an open pit just north of the Alpena pit. This interest also operated the Brunt mine near Hibbing. A large Atlas ore dryer with a capacity of 300 tons per day was installed at the latter property.

New Crusher at Biwabic Mine

The Biwabic mine shipped 210,000 tons of ore during the season of 1911. During the year work was completed on the installation of a large ore crusher designed especially for handling the lumpy ore found on this property. The crusher is one of the largest ever constructed and was furnished by the Allis-Chalmers Co. It has a capacity of 1,000 tons per hour and stands about 50 feet high. The machine is driven by a 200-horsepower, 560 revolutions per minute, three-phase, 2,200-volt motor, the current being generated by a 325-kilowatt, 2,300-volt, direct-connected unit, situated in the shops some distance away. The crusher has a 48-inch opening at the throat and is 11 feet in diameter at the top. It operates at 250 revolutions per minute. Upon leaving the crusher, the ore is delivered to a 2-inch revolving screen, 18 feet long and six feet in diameter, which effectually separates the large and small particles. The screen is bevel-gear, driven by a 30-horsepower motor and runs 17 revolutions per minute. The crusher was placed in operation during the season and handled 50,000 tons of ore.

Production was well maintained on the Vermillion range, the record for the season being 1,106,380 tons, practically all of which came from the properties of the Oliver Iron Mining Co. The two heaviest producers were the Pioneer and Zenith mines, which shipped 401,430 and 447,727 tons, respectively. Compared with 1910 this shows a falling off of 125,005 tons for the Pioneer mine and an increase of 166,407 tons for the Zenith. The Sibley mine, which shipped 206,000 tons in 1910, forwarded only 1,899 tons during the past season. The Soudan mine shipped 65,350 tons and the Savoy 87,964 tons. The total shipments for the range in 1911 were only 100,000 tons less than in 1910. The Corporation had considerable Vermillion ore in stock at the close of the season, the total amounting to approximately 480,000 tons, and since mining will be actively prosecuted during the winter, this will probably reach 800,000 tons before the opening of navigation next year. There were no new developments of consequence on the Vermillion properties of the Oliver Iron Mining Co. The year was devoted strictly to producing ore and extending the already existing mines. The Pioneer mine is now one of the best developed properties on the range. A shrinkage and caving system of mining which has proved very economical is employed at this property. Mining is now in progress on sub-levels above the twelfth level and new ore is being opened up between the twelfth and thirteenth levels at a depth of approximately 1,200 feet. The Zenith mine is now being worked on the eleventh level at a depth of 900 feet and the twelfth level is well-developed. The shaft extends 100 feet below this point. The Soudan mine, which is famous for its hard formation, is now down to a depth of 1,240 feet. Mining is in progress on the fifteenth level and development work is going forward on the sixteenth. The ore is removed by a stoping and underfilling method.

Among the independent properties in this district, the famous Section 30 mine, owned by George A. St. Clair, of Duluth, was in active operation. This property has been extensively developed and is in a position to ship 250,000 tons of ore next year. A new shaft is being sunk on Section 25. The Lucky Boy property, southwest of Ely, was opened in 1910, and some good ore has been exposed. The White Iron Mining Co. is developing a property south of Ely; a shaft has been sunk and work is still under way.

Extension of Railroad Facilities

The work accomplished during the past season in extending and improving the transportation facilities on the iron ranges was interesting. Mention has already been made of the new car distributing yards and new terminals at Hibbing. In a report published in THE IRON TRADE REVIEW, Jan. 6, 1910, it was stated that plans had been made to build a branch of the Duluth, Missabe & Northern, south from

Hibbing to meet the Alborn branch of that road and proceed thence to Duluth, but at that time it had not been definitely decided to carry out this project. Since the publication of the report mentioned, the line has been built and it is now known as the Hull-Rust Short Line. It is double-tracked between Hibbing and Alborn, thus giving a very short double track line from Hibbing to Duluth and two lines between Hibbing and Alborn. Interests affiliated with the Duluth, Misabe & Northern also have completed a line around the head of the bay at Duluth. This is known as the Spirit Lake Transfer railroad. A double-deck, two-track steel girder bridge, nearly a mile long, has been built across the St. Louis river into Wisconsin and also about 2½ miles of track have been laid in the city of Superior. Right of way has been secured 16 miles around Superior to Wisconsin Point, where docks will ultimately be constructed. The completion of this line is now under way.

The Duluth & Iron Range railroad has completed an extension 18 miles in length from Mesaba northwest to the Dunka river. This branch for the present will be used for handling logs, but will eventually become an ore-shipping line.

New Ore Docks

The past season witnessed a considerable addition to the ore-handling facilities at the head of Lake Superior, two large docks having been completed. One, erected by the Great Northern railway, at Allouez Bay, in Superior, Wis., is a concrete and steel structure, 1,800 feet long, with 150 ore buckets on each side. It has a total storage capacity of 106,000 tons. Six of the largest vessels on the lakes may be unloaded at this dock at one time. Electrical machinery is employed wherever possible and it is expected that the dock can handle 5,000,000 tons of ore annually. It was placed in operation early in August, 1911. The other dock was built at Two Harbors by the Duluth & Iron Range railroad. It has only recently been completed and was tested just before the close of navigation. It is 1,388 feet in length with 115 pockets on each side and is provided with a steel approach trestle, 317 feet long, connected to a timber approach 224 feet 6 inches in length.

A decision handed down during the year by Judge Sanborn, declaring that the Minnesota state 2 cent fare law is in conflict with the provisions of the interstate commerce act, permitted the railroads operating in the state to raise their passenger rates to 3 cents per mile. The Great Northern, Northern Pacific and Soo line, all of which reach portions of the Minnesota iron ranges, took advantage of this ruling and placed the higher rates in effect. The railroads controlled by the Steel Corporation, that is the Duluth, Missabe & Northern and the Duluth & Iron Range, have not changed their passenger tariffs and are still carrying passengers at 2 cents a mile. This action on the part of the Steel Corporation roads has made a very favorable impression throughout the iron range country.

An Acid-Contaminated River

Some interesting data on the acids in the Monongahela river is contained in a paper read by Thomas P. Roberts, of the United States Engineer's office, Pittsburgh, before the Engineers' Society of Western Pennsylvania. According to Mr. Roberts, the largest proportion of the sulphuric acid which reaches the river comes from coal mines. Of the 12 galvanizing establishments on the river or its tributaries, eight are estimated to use 59,200 tons of acid per annum. The four plants not included in this estimate are very extensive users and it is probably within the mark to state that 75,000 tons of acid are annually consumed in the district. One of the establishments finds a profit in converting its spent acid into copperas, while several others waste but little acid. At one establishment, the waste acid reaching the river amounts to about six per cent of the annual consumption. On the assumption that the waste acid from the 12 plants reaching the river forms two per cent of their total consumption, the amount would be about 4 tons daily reaching the river.

Mr. Roberts suggested, that rather than spend enormous sums in the installation of water softening plants, it would be advisable for the steel companies to take concerted action toward preventing the admission of acid into the river, or in regulating the amount in order that too great quantities may not be emptied at one time.

As an instance of the embarrassing possibilities of the acid in the river water, he cites the experience of a large steel plant on the river, in pool No. 3, which in the fall of 1910, was on the verge of suspending operations because its water-softening facilities were inadequate to cope with the immense quantities of acid then present in the water.

Tropenas Converter Plants

The number of converter plants for the manufacture of steel castings is rapidly increasing. The Tropenas Converter Co., 50 Church street, New York City, reports renewed activity in the demand for its equipment and is now furnishing the Isthmian canal commission a complete steel foundry outfit for installation at Gorgona, Canal Zone. It will consist of a Tropenas, new style, 2-ton converter, high pressure blower for the converter, sand mixer, ladle heaters, ladles and all of the necessary supplies for this equipment. Another contract was placed recently with the Tropenas Converter Co. by the Industrial Works, Bay City, Mich., for one, new style, 2-ton converter, the necessary high pressure blower, one No. 2 Tropenas cupola, ladle equipment, heaters and sand mixer. The Union Iron Works, Spokane, Wash., also has closed for Tropenas converter equipment, including one, new style, baby converter, high pressure blower, sand mixer, ladles, ladle heaters, etc.

The Chicago Steel Foundry Co., which is erecting a new plant at Chicago, has also placed a contract for a Tropenas baby converter and No. 1 Tropenas cupola, blowers, ladles, ladle heaters, etc. One of the largest contracts placed recently was for the entire steel foundry equipment for the Davison-Namack Foundry Co., Ballston Spa., N. Y. This equipment will include two standard 2-ton converters, blowers and sand mixer. The Tropenas Converter Co. reports that the outlook for the installation of converter equipment in South America, Japan, China and Europe is very good.

The 1910 output of the Russian Iron Syndicate amounted to 80 per cent of the total iron production of Russia. The Syndicate owns 16 plants in South Russia, two in the Baltic Provinces, two in Central Russia, two in the Urals and seven in Poland and employs a total of about 100,000 men. The total working capital of the various plants amounts to $120,000,000, two-thirds of which is invested in the works of South Russia. The ratio of increase in the production of iron and steel, for the first 10 months of 1911, over the corresponding period of the previous year by the works of Russian Poland is as follows: Iron and steel, 23 per cent; pig iron, 28 per cent; iron and steel semi-manufactured products, 18 per cent.

New Lower Lake Port Car Dumping Machines

A Description of Two Installations Made by the Erie Railway at Cleveland and the B. & O. at Lorain

By R D Williams

THE coal trade of the great lakes is constantly growing and may, as the country expands, equal or even exceed the ore trade. The railways handling this trade have, during the year just closed, made some notable installations on Lake Erie docks for transferring the coal from cars to the vessel. Two of these installations are treated in this article, that made by the Erie railway at Cleveland and by the Baltimore & Ohio at Lorain.

The Baltimore & Ohio handled at Lorain during the year, approximately 3,000,000 tons of coal from the West Virginia and southeastern Ohio fields. It received on an average about 500 cars of coal daily. The yard at Lorain is a gravity yard so arranged that the cars may be assorted and placed on a feed track on which they run by gravity to the car dumpers. There are two unloading machines of the McMyler type in the terminal, each having four feed tracks of 50 cars capacity leading to it, and two tracks for empty cars with a capacity of 25 cars each. The machines are situated directly on the water front near to the point where the river empties into the lake, so that no difficulty obtains in handling the largest type of steamer.

Dumping the Car

As the car runs through the yard by gravity and approaches the unloading machine, it is passed under a water spout which sprinkles the coal and settles the dust preparatory to loading in the vessels. Reaching the unloader the car is secured to the tracks by large steel clamps which work automatically. It is then elevated, turned over bodily, and by means of suitable chutes, the coal is delivered to any point in the hatch of the vessel. Provision is also made for trimming the coal in the vessels and for adjusting the machine to different heights of vessels.

The machine installed during the year has some special features in that it was built to meet special conditions. The railroad tracks and the coal storage yard at this point are about 40 feet above the water in the river, and for this reason it was necessary to take the cars into the dumper at a higher point than is usually done. Fig. 4 shows the character of the local conditions, the car reaching the dumper upon a trestle with the bank in the rear. The machinery is all controlled by an operator in the tower in the unloader. Both of the McMyler ma-

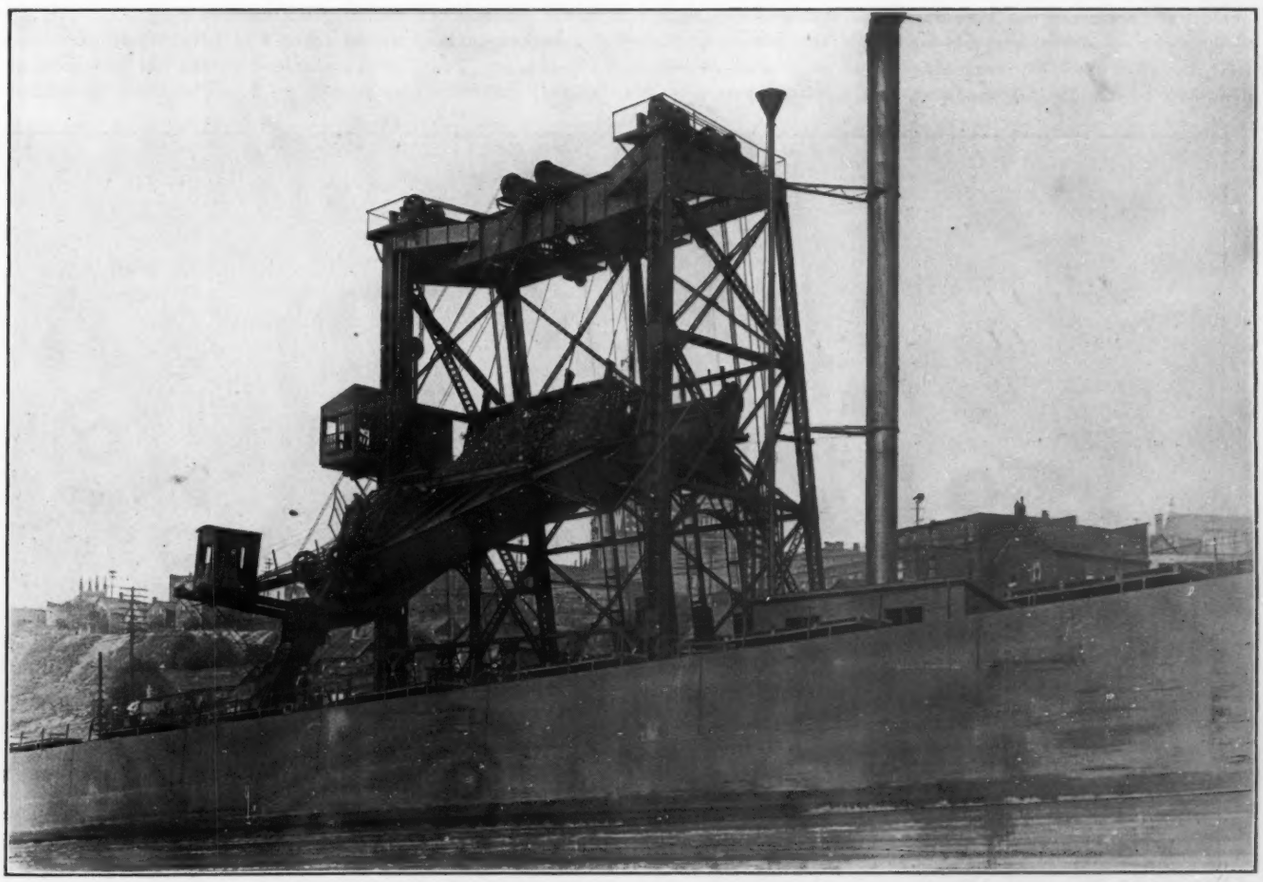


FIG. 1—WELLMAN-SEAVER-MORGAN CAR DUMPING MACHINE, SHOWING FLEXIBILITY OF LEG

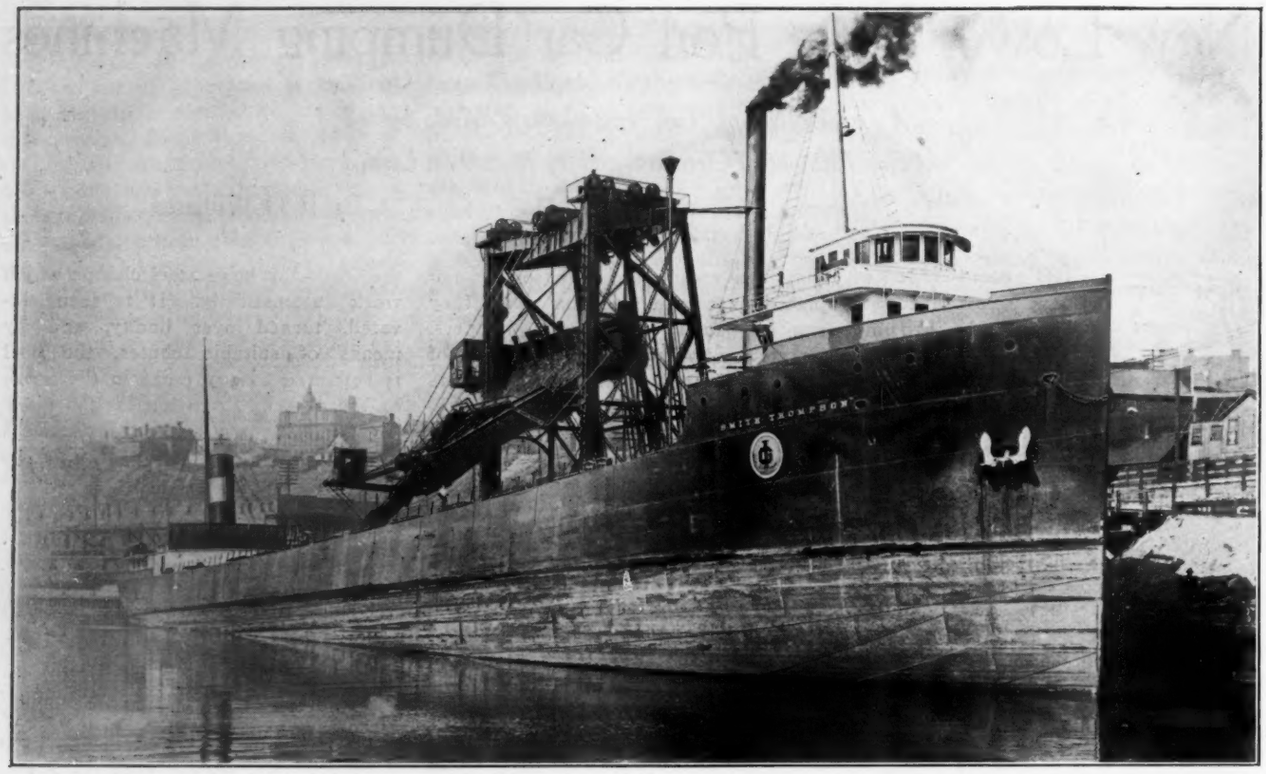


FIG. 2—WELLMAN-SEAVER-MORGAN CAR DUMPER ON ERIE DOCKS AT CLEVELAND DUMPING A LOADED CAR

chines at this dock are designed to have an average unloading capacity of 1,000 tons an hour, but the record performance of the machine illustrated herewith is 46, 50-ton cars or 2,350 tons in an hour. The machines are designed to handle all kinds of cars that are found in the coal trade. After the coal has been unloaded the cars are returned by gravity to the yard level and are then placed in the ore yard ready for a return cargo of iron ore to the blast furnaces. The whole movement is timed, so that, while one car is being dumped another is approaching by gravity and arrives at the unloading table just in time to send the empty car on its return trip. Fig. 6 is a side elevation of the machine in the act of dumping a car. Fig. 5 is a front elevation

FIG. 3—WELLMAN-SEAVER-MORGAN CAR DUMPING MACHINE WITH LEG ELEVATED TO CLEAR ALL POSSIBLE RIGGING

Located at Lorain, Ohio.

FIG. 4—McMYLER CAR DUMPER LOCATED ON TRESTLEWORK AT BALTIMORE & OHIO RAILWAY YARDS AT LORAIN

showing the machine at rest. The McMyler Interstate Co. has built 30 of these machines.

The Erie railroad has established a car-dumping machine of the Wellman-Seaver-Morgan Co.'s type at its docks below the Superior avenue viaduct, at Cleveland. This machine went into commission during the past summer and is operated by the Pittsburgh Coal Co. As yet no effort has been made to establish a record with it though it is intended to load a 7,500-ton boat in five hours. The company expects next spring to establish a record for fast loading with this machine. A record was certainly made in erecting it, for only 57 days elapsed from the time the erection was commenced until the machine was ready to handle cars.

The location of the dock and the local conditions surrounding the car dumper are such that it is not prac-

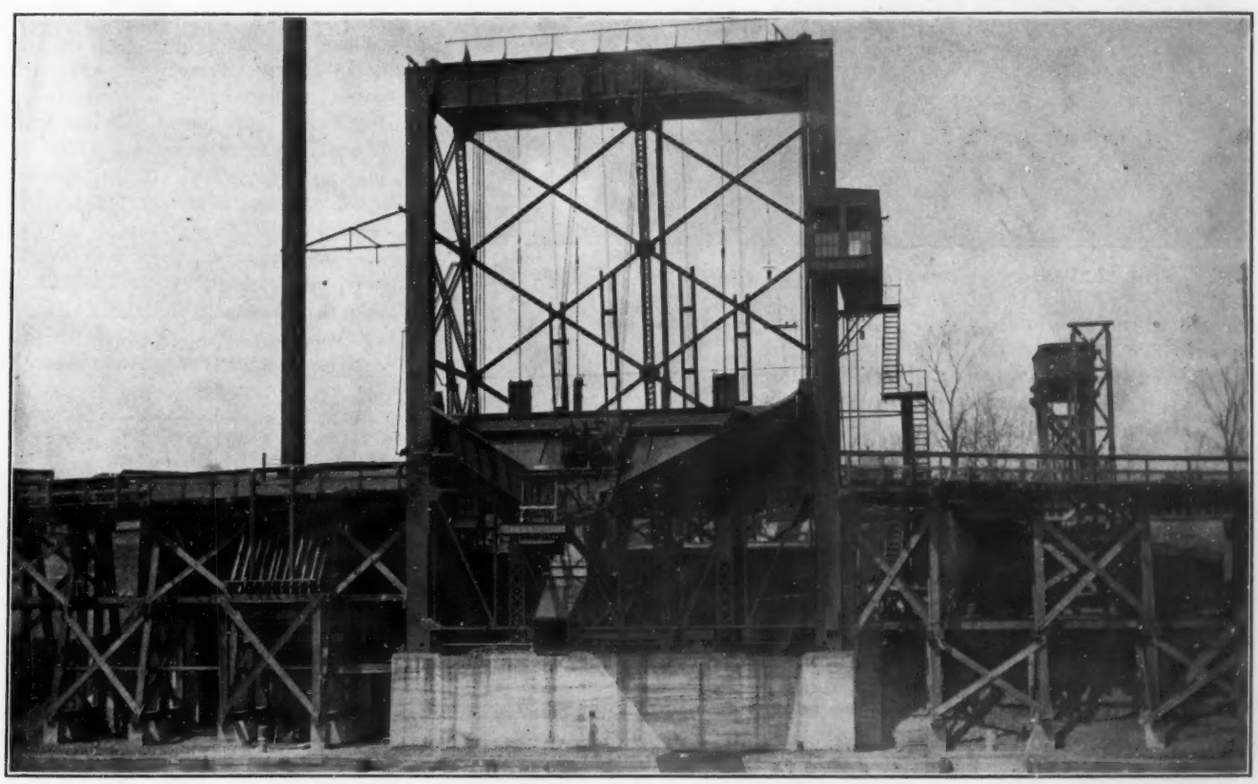


FIG. 5—FRONT ELEVATION OF McMYLER CAR DUMPING MACHINE AT REST

tical to bring the cars in at a sufficient elevation to dump them directly into the boat without first hoisting and the machine is so constructed that the cars are first hoisted and the coal is then dumped through a chute into the vessel.

The main framework of this machine supports a hoisting and rotating cradle upon which the loaded cars are carried. The cars are run down a gravity track to the lower end of an incline approach leading to the machine. The cars are drawn upon this approach by means of a mule car which is operated by a haulage rope wound on a drum in the machinery house located in the rear of the main framework. This mule car is arranged to run on a narrow gage track between the approach car tracks, and at the bottom of the incline it runs into a pit which depresses the mule car sufficiently so that the incoming loaded cars pass over it. As soon as the loaded car is at the bottom of the incline approach, the mule haulage engine is started and the mule car coming out of the pit engages the rear coupler of the car and pushes the car up the incline and into position on the cradle. It is then hoisted and dumped through a chute into the boat.

FIG. 6—SIDE ELEVATION OF McMYLER MACHINE IN THE ACT OF DUMPING A CAR

The pan or chute is of sufficient width to take the coal discharge from the full length of the car, but is contracted at the forward end to a width of about 6 feet and at the lower end terminates in a vertical leg or chute. This leg is provided with the necessary mechanism to swing toward the dock or away from the dock, as required, for the purpose of distributing the coal in the hold. It is also provided with a trimming device designed to swing lengthwise out of the boat, thus giving further facilities for the distribution of the coal. This trimming device is operated by means of a small engine which is fastened to the pan and has the necessary drums for controlling the operating ropes. The levers for controlling the movements of the vertical chute and the trimmer at the bottom of the chute are located on the operator's platform at the top of the vertical chute.

The operator controlling the various motions of the car dumper is stationed at a convenient position over the incoming car track in the main framework of the machine and all of the necessary controlling levers for operating the several engines as well as a lever for controlling a sprinkling device, located at the bottom of the incline, are situated in the operator's house.

The machine is expected to handle 30 cars an hour. It should be stated that as the car is being hoisted in the cradle the platen upon which the car is carried moves sideways until the side of the car is pressed firmly against the cradle. A further continued motion of the hoist automatically sets the car clamps which hold the car in position on the cradle when in an inverted position. These clamps are arranged so that they are automatically adjustable to any standard size of car and are operated by means of heavy counterweights running in guides at the rear side of the main framework. The arrangement is such that no attention of the operator is required to set these clamps and they release automatically when the car has returned to the original position.

After the coal has been dumped into the pan or chute from the car, the cradle carrying the car is again lowered to its original position and the machine is ready to receive another loaded car. The loaded car, upon reaching the platen, pushes out the empty car which runs down a gravity discharge track onto a kickback and then runs down a gravity track to the empty car storage.

Fig. 2 shows the contents of a car in the process of being dumped into the hold of a boat. Fig. 1 is another view of the same operation showing the flexibility of the leg. Fig. 3 is a side view of the car dumping machine with the leg being hoisted to demonstrate its possibility to clear all rigging.

Heating Value of Producer Gas

The average low heating value of producer gas, according to tests conducted at the engineering experiment station, University of Illinois, is approximately 110 British thermal units per cubic foot. Since the average engine requires about 10,500 effective British thermal units per brake-horsepower-hour, 95 cubic feet of this gas will be required per brake-horsepower-hour, or $95 \div 76 = 1.25 +$ pounds of coal. Since the coal contains about 12,800 British thermal units per pound, the efficiency of the plant will be $\frac{2{,}545 \times 100}{12{,}800 \times 1.25} = 16$ per cent, approximately. The thermal efficiency of a steam plant of this same size will be about 3 per cent, assuming a boiler efficiency of 60 per cent and an engine efficiency of 5 per cent. If the anthracite fuel costs $5 per ton, soft coal for the steam plant must cost $0.94 per ton in order that the fuel cost remain the same per horsepower-hour. The cost of attendance, maintenance and repair will be practically the same for each plant.

Electric Furnace Methods of Iron Production

Recent Developments in Electric Iron Ore Smelting Mediums With Descriptions of the Various Furnaces in Use

By John B C Kershaw

THE writer, in 1906 and 1907, contributed a series of articles to THE IRON TRADE REVIEW, under the title of "Electric Furnace Methods of Iron and Steel Production". The future of these processes was at that time summarized as follows:

In the manufacture of the best crucible steel, however, it is customary to assume that between 2½ and three tons of coke are consumed per ton of steel produced. At the present market price of coke, $4, the advantage is, therefore, on the side of the electric refining furnace.

As regards the electric smelting processes, it is necessary to remember that coke is still required to reduce the oxide of the iron ore to the metallic state, and that the only fuel saved is that used in the blast furnace for heating purposes. In the best modern smelting practice only 1,600 pounds of coke are required per ton of iron produced, and of this total 650 pounds are required to reduce the ore. The saving of coke by the electric furnace method of smelting cannot, therefore, exceed 950 pounds, or at the present price of coke, $2.

These considerations show that the prospects for the electric refining processes are much brighter than those for the electric smelting processes, since the saving of coke in the latter is too small to balance the large expenditure upon electric power. The horsepower-year would, in fact, have to be supplied at the extraordinary low cost of $5 in order to compete with the modern blast furnace, and the localities where it can be produced at this figure are certainly few in number. For the present, therefore, the application of the electric furnace in the iron and steel industries is likely to be restricted, as a general rule, to the refining processes, by which pig and scrap steel are converted into higher-priced products. In these branches it is likely to be very widely employed.

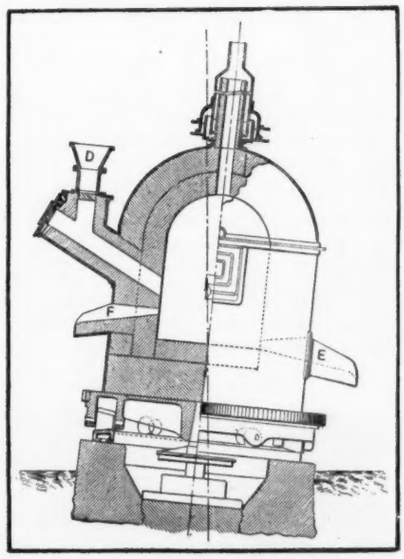


FIG. 1—CROSS-SECTION OF STASSANO REVOLVING ARC ELECTRIC FURNACE

Recent Developments

The developments of the past four years have borne witness to the correctness of this forecast. Electric steel refining processes are now used on both sides of the Atlantic, and the most progressive and wide-awake steel makers have already equipped their works with one or more of these furnaces, or are preparing to do so. Compared with this development of electric steel-refining, however, electric furnace methods of iron smelting have only made slow progress, and at two centers only, namely, at Trollhatten, in Sweden, and at Heroult, in California, can successful iron-smelting works be said to have been established. A brief resume of the early experiments with electric smelting furnaces will be given, together with the latest and most reliable information obtainable, as to the position of the important electric iron smelting works at Domnarfvet, Sweden, and at Heroult, California. The comparison between the power consumption of the early furnaces and of the new furnaces recently placed in operation in Sweden, shows the advance that has been made during the past ten years, and indicates that the limits of improvement have probably not yet been attained.

Early Experiments

The first experiments in the smelting of iron ores in electric furnaces were made by an Italian, Capt. Stassano, in the years 1899-1901, at Rome, and later at Darfo, in northern Italy, where cheaper power was available. The furnace used was of the revolving arc type, Fig. 1, still employed by Stassano for electric steel refining, with three-phase current and water-cooled electrodes. The ore was first ground and after mixing with the lime and coke, was briquetted before charging into the furnace. Any practical metallurgist could have foretold that the costs of this preliminary treatment of the ore would render the method expensive and impracticable. Although the trials at Darfo did not result in any financial success, they proved that iron and steel of good quality could be produced in this way, direct from the ore. Goldschmidt, who made an official report upon the method for the German patent office, gave the following figures for the power consumption and cost of operating the process: Power, 2,866 kilowatt hours a ton; cost, $18.80 a ton.

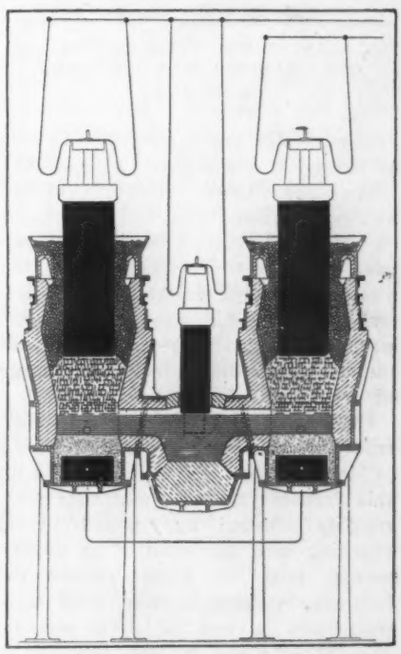


FIG. 2—SECTIONAL ELEVATION OF KELLER FURNACE

The next investigator of the subject was Keller, the well-known French electrometallurgist, who carried out extended trials with an electric furnace of his own design, for ore reduction, at Kerrouse and Livet,

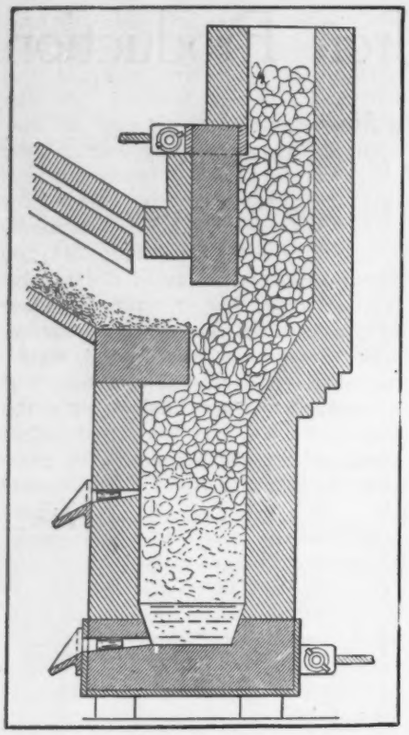


FIG. 3—SECTIONAL VIEW OF THE HEROULT ELECRIC IRON SMELTING FURNACE

France, in the years 1901-1905. It was at the latter place that the Canadian commission upon electric furnace methods of iron smelting, carried out its trials, in March, 1904. The furnace used for these trials was of the double-shaft type connected by a lateral canal, which when the furnace was operating, became filled with molten iron reduced from the charge of ore in the shafts above.

Composite, massive carbon electrodes, 34 inches square and 56 inches in length, Fig. 2, were used with this furnace; the raw materials were roughly crushed and mixed before charging into the shaft. The experimental trials at Livet yielded the following results: Power, 2,292 kilowatt-hours a ton of 2,000 pounds; cost, $12.05 a ton of 2,000 pounds.

Experiments at the Soo

After these early trials of the electric furnace for iron smelting, nothing more was done until 1905-1906, when Heroult, the noted French metallurgist, arranged for a trial of his shaft type of furnace, Fig. 3, at Sault Ste. Marie, Canada, under the auspices of the Canadian government. The furnace used in these trials was of the square shaft type of much simpler design and construction than those used by Stassano and Keller. The iron bottom plate of the furnace, 24 inches square, served as one electrode; the other was a carbon rod, 16 inches square and 72 inches long. Sectional and plan views of this furnace are shown in Fig. 4. As raw materials, the native magnetic iron ore of the district, with charcoal in place of coke, were used. Although the method and process were found to be feasible from a scientific point of view, the commercial prospects were less satisfactory, and the project of establishing an electric iron smelting industry on the Canadian side of the great lakes was reluctantly abandoned by its supporters.

The estimated consumption of power for a large plant, based on Dr. Haanel's trials at the Soo with the Heroult furnace, was 1,490 kilowatt-hours per ton of pig iron. The estimated cost for labor, ore and power supply was $10.69 per ton of 2,000 pounds. In this estimate ore was taken at $1.50 per ton; charcoal at $6 per ton and electric energy at 0.163 cent per kilowatt-hour.

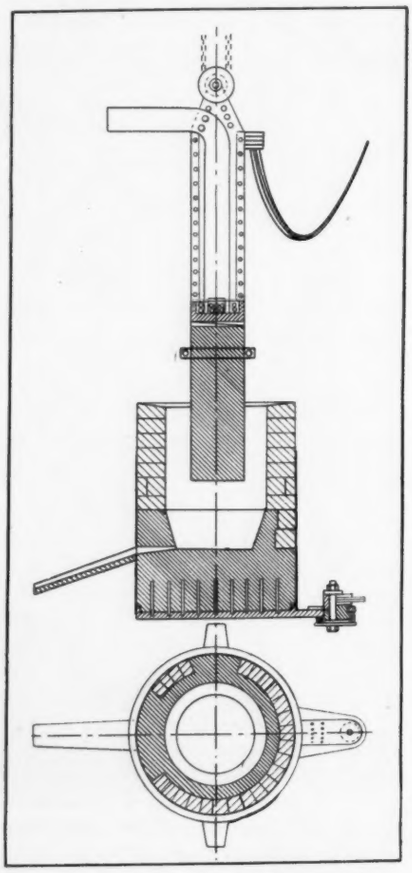


FIG. 4—SECTIONAL AND PLAN VIEW OF HEROULT FURNACE ERECTED AT SAULT STE. MARIE, CANADA

The success, from the scientific standpoint, of these early trials with electric iron smelting furnaces, led three Swedish engineers, Gronwall, Lindbled and Stalhane, to undertake further trials in Sweden of this method of iron smelting, in the years 1906-1907. The special aim of these inventors was to design an electric smelting furnace, which should prove commercially successful when operated with Swedish ore and under Swedish conditions of power and labor supply. In carrying out their plans for this work, they were assisted by a group of Swedish iron masters, who not only provided facilities, but also assisted the three engineers in obtaining the necessary funds for the experimental work. The first furnace, of 300 horsepower capacity, was ready for operation in April, 1907, and a second, with improvements based on the experience gained in operating the first furnace, was erected in 1908.

Description of Furnace

The following description of the latter furnace is drawn from Dr. Haanel's report, prepared for the Canadian government, and published in 1909:

In general appearance this electric shaft furnace is unlike any hitherto constructed, being very similar in design to an ordinary blast furnace, in which the tuyeres are replaced by electrodes.

A vertical section of the furnace is illustrated in Fig. 5 and Fig. 6 is an external view. The height above ground level is about 25 feet. The melting chamber or crucible containing the electrodes, is about 7 feet high, and is of greater diameter than any other part. The shaft is about 18 feet high, the lower end of which, for about four feet, has the form of a truncated cone, for the purpose of directing the charge into the crucible in such a manner that the electrodes, lining and descending charge could not come in contact. This

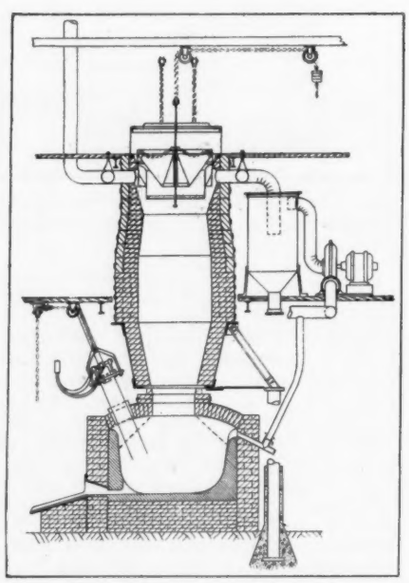


FIG. 5—SECTIONAL VIEW OF THE GRONWALL FURNACE AT DOMNARFVET, SWEDEN

special feature in the design was introduced by the inventors after repeated experiments.

It is this isolation of the descending charge from the lining at the point where the electrode enters the furnace that constitutes the particular economic advantage of the construction since it prevents the destruction of the lining.

For the purpose of cooling the brickwork composing the lining of the roof of the melting chamber, and thereby increasing its life, three tuyeres are introduced into the crucible, just above the melting zone, through which the comparatively cool, tunnel head gases are forced against the lining of the roof, into the free spaces. This gas absorbs heat from the exposed lining of the roof and walls, and the free surface of the spreading charge, thus effectively lowering the temperature of the roof and exposed walls.

Large Electrodes

Each electrode was built-up from two carbons, 11 inches square and 63 inches long, making the total cross-section of the built-up electrode, 11 x 22 inches.

The water-cooled stuffing boxes, through which the electrodes enter the melting chamber, are provided with special devices for preventing the gas, under pressure within the melting chamber, from leaking out around the electrodes.

Haanel carried out, with this furnace, a series of test trials in December, 1908, the more important results of which are given herewith:

The ore was magnetite from the Grangesberg district, containing 63 per cent metallic iron, 3.66 per cent of silica and 2.34 per cent of P_2O_5. Although the furnace was designed for a larger output, the low water supply would only permit of a power consumption during the trials of 400 to 450 kilowatts. As regards yield, the average of nine tappings gave 1.87 tons of pig iron per electrical horsepower-year, but owing to the thermal losses due to heating-up the furnace and to an accident to one of the stuffing boxes, a yield of 2.44 tons obtained from the sixth cast was taken as the most reliable figure. This is equivalent to 2,675 kilowatt-hours per ton of pig. It was believed, however, that under more favorable conditions of work, the power consumption could be reduced to less than 2,000 kilowatt-hours per ton of pig, and Prof. Von Odelstierna, of Stockholm, made the following estimate for a furnace producing 8,000 to 10,000 tons of pig iron per annum:

Charcoal, 0.27 ton, at $8 per ton	$2.16
Power, 0.30 E. H. P. year at $12	3.60
Labor	1.00
Electrodes, 10 pounds at 3 cents per pound	.30
Repairs, etc.	1.50
Total	$8.56

This estimate does not allow anything for the cost of ore, or for interest on capital and depreciation of plant and machinery. These would probably add another $5 per ton to the cost of the pig iron produced, making the total cost $13.56.

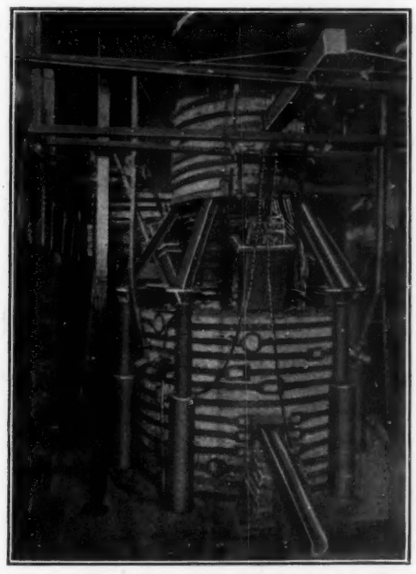


FIG. 6—AN EXTERIOR VIEW OF THE GRONWALL FURNACE AT DOMNARFVET, SWEDEN

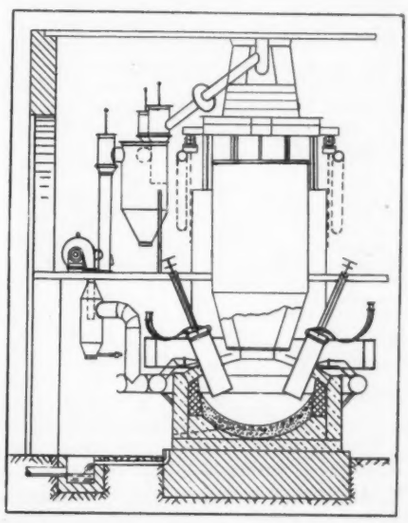


FIG. 7—SECTIONAL VIEW OF GRONWALL FURNACE AT TROLLHATTEN, SWEDEN

Following up the success attained with this smelting furnace at Domnarfvet, arrangements were made with the Trollhatten Water Power Co. to erect a larger plant at Trollhatten, the following being details of the scheme:

Each furnace to be of 2,500 horsepower capacity and to produce 7,500 tons of pig iron per annum; two furnaces to be kept in operation and one in reserve; the ore used to be magnetite from Grangesberg, and to contain between 0.40 and 1.9 per cent phosphorus; Westphalian coke to be used, costing $5.67 at Trollhatten; power to be supplied at $7.45 per horsepower-year, increasing to $9.93 after ten years. The estimated capital required for financing the undertaking was $162,000 and the estimated cost of pig iron $13.77 per ton, leaving a margin between the producing and selling price of $1.89 per ton. The Swedish Association of Iron Masters provided the necessary capital, and the erection of the new plant was completed near the end of 1910, at a cost of $88,500. The furnaces follow, in their main lines of construction, that erected at Domnarfvet, but are much larger, and have four electrodes in place of three. Figs. 7 and 8 show a sectional elevation and external view of one furnace.

FIG. 8—EXTERIOR VIEW OF A LATE FURNACE AT TROLLHATTEN, SWEDEN

Trollhatten Experiments

The gases passing from the top of the furnace are collected and blown, by means of a fan, into the crucible, this circulation of the gas having two objects—

(a) To increase the heat of the charge of ore and coke in the shaft above and to render it ready for the reduction process.

(b) To cool the roof of the furnace, and to lessen the danger of overheating and collapse.

The electric power for this plant is obtained from the Swedish government's electric power plant at Trollhatten, and is obtained in the form of three-phase current at 10,000 volts and 25 cycles. The furnace

transformers are each 1,100 kilowatt capacity, with a guaranteed overload capacity up to 1,375 kilowatts. Details of the construction of this furnace were published in THE IRON TRADE REVIEW, July 20, 1911.

Charcoal has replaced coke as the reducing agent for these furnaces, the average composition of this charcoal being moisture, 14.58 per cent; ash, 3.06 per cent; fixed carbon, 72.10 per cent, and volatile matter, 10.26 per cent. The molten metal is tapped as in ordinary blast furnace practice, about five tons of pig being obtained at each tapping of the furnace.

Later Trollhattan Operations

Over 1,500 tons of pig iron have been produced at Trollhatten since the first furnaces were started in November, 1910, and the metal is stated to be of exceptionally good quality, containing only small percentages of sulphur and phosphorus. The latest details concerning the operation of the Trollhatten plant are contained in a report published in *Metallurgical and Chemical Engineering.* From this report the following is quoted:

The furnace is now working with round electrodes, 550 milimeters in diameter, screwed into each other, and are thus entirely consumed. These screw-joints hold well and give no trouble by heating. Whereas the electrode consumption of this furnace, using square, unjointed electrodes, from Nov. 15, 1910, to April 9, 1911, was 10.28 kilos per ton of pig iron, counting the lost butts, the consumption from Aug. 4 to Sept. 4, 1911, was 6.2 kilos, and it has since that date been reduced to 5.5 kilograms (12.10 pounds) per ton of iron.

The furnace has been running steadily since Aug. 4, and the ore is charged more towards the middle of the furnace shaft. The percentage of carbon dioxide in the escaping gas, by this and other means has been increased to over 30 per cent.

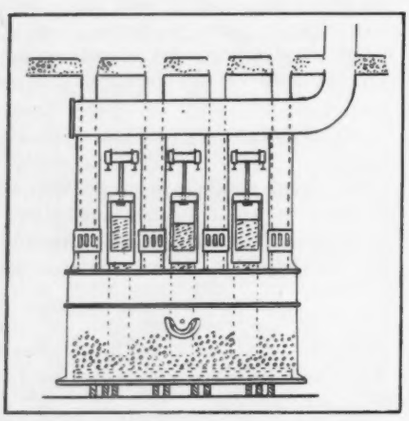


FIG. 9—SECTION OF FIRST TYPE OF HEROULT FURNACE ERECTED AT HEROULT, CAL.

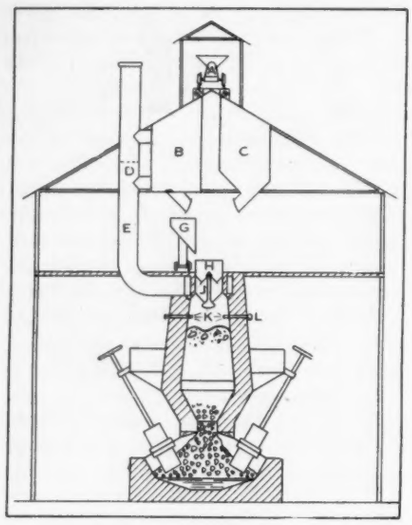


FIG. 10—SECTION OF SECOND FURNACE ERECTED AT HEROULT, CAL.

The weekly production of pig iron has been increased, the consumption of charcoal has been decreased, and the output has reached the figure of 5.05 tons per kilowatt-year, equivalent to a power consumption of only 1,735 kilowatt-hours per ton of 2,204 pounds, this being the figure reached in the week Sept. 3 to 9. The detailed figures for that week were as follows:

Ore	192.5	metric tons
Limestone	7.7	metric tons
Charcoal	44.2	metric tons
Electric energy used.	228.000	kilowatt hours
Average power	1,357	kilowatts
Pig iron produced...	131.4	tons
Slag	22.1	tons
Charcoal per ton of pig iron	336	kilograms
Pig iron per kilowatt year	5.05	tons
Electric power per ton of pig iron....	1,735	kilowatt hours

Four large electric pig iron furnaces of similar design will be in commercial operation in Scandinavia early in 1912, located at Domnarfvet and Hagfars, Sweden, and at Tyassaa, Norway. The largest of these will be at Tyassaa and is to have a power capacity of 3,500 kilowatts.

In concluding this review of the present position of electric iron ore smelting in Sweden, it may be pointed out that the conditions in that country and in Norway, for the successful development of the process, are probably more favorable than in any other part of the world.

High grade iron ore is abundant and electric power, developed from large waterfalls, is remarkably cheap. The country has no deposits of coal and the iron industry is dependent, therefore, on charcoal made by carbonization of the timber, with which the lower sides of the valleys and mountains are covered. To replace two-thirds of the charcoal required by the ordinary process of iron smelting by electric power is, therefore, a most profitable substitution.

The future of the electric iron smelting industry in Scandinavia is, therefore, assured, and its gradual development will be of enormous importance to the industrial progress of Sweden and Norway.

The only other locality where, at present, similar conditions prevail, is California. No coal beds are known to exist in this strip of the western border of the United States, and the selling price of pig iron and steel is very high, due to the heavy freight charges from the eastern states and from other centers of the iron and steel-making industry. For this reason, the further trials of the Heroult iron smelting furnace and process in America, were transferred to Shasta county, California, where a cheap and plentiful supply of power was combined with the other requisite conditions of the development of a successful electric iron smelting industry.

California Experiments

The trials of electric furnace methods of iron smelting at Heroult, on the Pitt river, California, were initiated in 1907, by H. Noble, president of the Northern California Power Co., who was anxious to find an outlet for some of the surplus power produced by their generating plant. M. Heroult was engaged by Mr. Noble early in 1907 to design and erect a furnace for smelting the ore produced by the Shasta Iron Co., at that place.

FIG. 11—EXTERIOR VIEW OF THE CALIFORNIA HEROULT FURNACE

The following description of the furnace as erected, was given by

R. L. Phelps, in an article contributed to *Mining and Scientific Press*:

The smelter itself was elliptical in form, with one compartment, standing about five feet high, made of heavy sheet steel lined inside with the best magnesite brick. The bottom of the furnace was formed of heavy cast iron plates, with a covering of tamped carbon, to form the neutral point of the circuit. The bottom plates were insulated from the upper parts of the furnace with asbestos. A tap and trough were provided on one side to draw the molten pig iron onto the molding beds. Through apertures in the top cover of the furnace, the three carbon electrodes were introduced; these carbons were 18 x 18 x 72 inches, and were made in Sweden. They were fastened by wedges to a copper holder, which was water-jacketed, and by mechanical means were lowered and raised from the furnace when necessary. Four combination charging and draft tubes were placed on the top cover of the furnace. These tubes consisted of an inner tube made of steel, and an outer tube made of cast iron, so as to leave an annular space large enough to serve as a conduit for the gases that were generated. Bunsen burner slots were provided in the base of each tube to allow enough oxygen to enter, in order to complete the combustion of the gases liberated from the charge. The burning of these gases in the annular space heated the charge as it was fed through the inner tube to the furnace, thus delivering the charge hot instead of cold.

The furnace was designed to utilize 1,500 kilowatts in the form of three-phase current at 50 volts. The charge was made up of charcoal, limestone and ore. The charcoal was burned in kilns close to the plant. The heat for smelting the ore was obtained from the resistance of the slag and charge to the current as it passed from the electrodes to the neutral point; consequently, at the start, the electrodes were in slight contact with the neutral bottom of the furnace. As the charge became heated the electrodes were drawn out of the molten iron and remained in the slag and charge.

Results of Operations

Fig. 9 shows a sectional elevation of the furnace. The ore was estimated to cost $1.50 per ton, and power, $12 per electrical horsepower-year. With charcoal at less than $10 per ton it was hoped to produce pig iron at a cost of $16.14 per ton or less, assuming that one ton of pig could be produced with an expenditure of 2,700 kilowatt-hours.

This furnace was first placed in operation on July 4, 1907, and it was hoped that a production of 24 tons per day would be speedily attained. For various reasons these expectations were not fulfilled and the output never exceeded 11 tons of pig iron per day.

According to Elwell it was found impossible to run the furnace for any length of time as the electrodes were exposed to the air and were consumed rapidly, and the heat from the open furnace top was so unbearable that the men refused to work. The experience gained in this first trial, however, was utilized in the plans for a second furnace, which was erected to the designs of Prof. Dorsey Lyon, of Stamford University. The new furnace was smaller than the first, being of 160-kilowatt capacity, and was designed to run with 4,000 amperes at 35 volts, single-phase current. The furnace stack was built of concrete and was 29 feet high. The crucible was lined with fire brick and was water-cooled, the electrodes being fixed in its walls. The charge of ore, lime and charcoal was pre-heated in the stack before reaching the zone of fusion in the crucible between the two electrodes, which were fixed 24 inches apart.

COMPARATIVE COSTS OF IRON, ELECTRICALLY-PRODUCED.

Process and type of furnace.	Location.	Power kilowatt-hours.	Estimated cost, 2,204 pounds.	Remarks.
Stassano	Darfo, Italy	2,866	$18.60	Power at $9 per E. H. P. year.
Keller	Livet, France	2,589	13.27	
Heroult	Sault Ste. Marie, Canada	1,642	11.77	Power at $10.71 per E. H. P. year; ore $1.50 per ton.
G onwall	Trollhatten, Sweden	1,957	13.56	Estimate based on early trials.
G onwall	Trollhatten Sweden	1,735	13.00	Actual results obtained at Trollhatten, Sept. 3, 1911.
Heroult	Shasta county California	.....	15.00	Power at $12 per E. H. P. year; ore at $1.50 per ton.

The new furnace was heated up early in 1908 and was run experimentally for a period of 46 days, the lowest figure obtained in the trial runs being 3,066 kilowatt-hours per ton of pig. The output of the furnace was 2,400 pounds per day of 24 hours. It was hoped to reduce this power consumption with a larger furnace capable of longer continuous runs, and plans for a 1,500-kilowatt furnace of similar design, but to employ three-phase current, were next prepared.

Fig. 10 shows a sectional elevation and Fig. 11 a general view of the exterior of the 1,500-kilowatt furnace ultimately erected, and put into operation in the autumn of 1909. The following description of the operation of the furnace is taken from a paper read by Prof. Lyon, before the Niagara Falls meeting of the American Electro-chemical Society, in that year:

In the operation of the furnace the ore, mixed with its proper proportion of fluxing materials, is fed into a pre-heater, *B*, Fig. 10, wherein it is dried and heated. The source of the heat for the pre-heater is derived from the products of combustion from the chamber, *K*, at the top of the stack, which is let into the base of the pre-heater through a flue, *E*. This communicates with an annular chamber surrounding the top of the stack and communicating with the chamber, *K*, through openings or ducts.

A scale car, *G*, runs upon a circular track around the top of the stack, and alternately receives a charge of ore and flux from the pre-heater, *B*, and a weighed charge of carbon from the carbon hopper, *C*, these charges being delivered alternately by proper mechanism into the body of the furnace.

In the operation of the charging device, a charge of ore and flux is first dropped into the upper portion of the hopper, the bell, *H*, being closed, and after the charge is properly distributed about the hopper, the bell is lowered so as to permit the charge to pass into the lower compartment of the hopper, the upper bell being then closed and the lower bell opened, so as to permit the charge to pass into the stack. The charge of carbon is then fed into the furnace through the charging device in the same way.

The electrodes, six in number, are arranged equidistantly around the furnace. The electric current, passing through the ore lying between them, melts the charge, and the molten metal and slag are collected in the crucible, from which they are drawn as in ordinary blast furnace work.

On July 21, 1910, a party of American steelmakers and engineers visited the plant of the Noble Electric Steel Co., at Heroult, and witnessed this furnace in operation. The furnace at that date had been running smoothly for some time and had produced several hundred tons of pig iron, but no figures were given to the visitors of the power consumption per ton of pig.

The furnace was tapped every six hours and produced five tons of iron at each tapping, or 20 tons per day. A wood carbonizing plant has been erected in close vicinity to the smelter, and wood alcohol, acetic acid,

tar and creosote oils, were being obtained as by-products of the charcoal manufacture. The operation of the 1,500-kilowatt furnace had proved so successful that the erection of five more furnaces of similar design at a cost of $300,000 had been decided on, and the progress of the trials from the experimental to the commercial stage was considered to have commenced. Since that date, but little information has been published concerning the progress of this smelting works at Heroult. One of the difficulties that this plant has had to contend with is the lack of water supply during the summer and autumn months of the year, and the inability of the Northern California Power Co. to supply sufficient power to run the smelting works continuously. According to the estimate made by Mr. McBennie, before the larger furnace was started, the cost of production was expected to be approximately $15 per ton, and freight charges to San Francisco were expected to add about $3 per ton to the cost of pig iron delivered to the foundries in that city. As pig iron was selling at that date in San Francisco at $23 to $26 per ton, the margin for profit and incidental expenses appeared to be sufficient to assure the success of the electric iron smelting industry on the Pacific coast.

Comparative Yields and Costs

As previously stated, detailed figures for the operation of these furnaces, similar to those given for the Trollhatten plant, have not so far been published, and the cost of operating the smelting plant at Heroult, Cal., is only known to the officials of the company.

Taking the figures given in this article and bringing them to a common basis of comparison, the comparative yields and costs are summarized in the accompanying table. The power consumption is expressed as kilowatt-hours and the cost in dollars per ton of 2,204 pounds of pig iron produced.

Comparing the latest figures for power consumption with those obtained by Stassano and Keller, in the early trials, a notable reduction of 30 per cent is observed, and it is quite possible that with larger furnaces and with a further reduction of radiation and other avoidable heat losses, the power consumption per ton of pig iron may ultimately be brought down to 1,500 kilowatt-hours per ton of pig iron. The attempts made at Trollhatten to obtain a better utilization of the reducing power of the carbon, by returning the gases which pass from the top of the shaft into the melting and reducing zone of the furnace, have resulted in an increase of the CO_2 percentage to over 38, and it is no doubt possible to further utilize the reducing power of the carbon monoxide gas which still escapes with the exit gases. But, even when the power consumption has been reduced to 1,500 kilowatt-hours per ton, the electric steel smelting furnace will still be unable to compete with the ordinary blast furnace methods of producing pig iron, except under the most favorable conditions, as at Trollhatten and at Heroult. As pointed out in the introductory extracts from the author's article of 1907, the modern blast furnace, worked under the best conditions, only requires 1,600 pounds of coke per ton of pig; of this total, 650 pounds are required to reduce the ore to the metallic state, and thus are a charge on either process. The saving in coke by the adoption of electric heating can, therefore, only amount to 950 pounds per ton of pig. If 1,500 kilowatt-hours can be obtained for $2.50 it signifies that the electrical horse-power-year must be sold for between $8 and $10, and there are exceptionally few hydro-electric stations that can produce or sell electric power at this figure. The electric process is also further handicapped by the cost of the carbon electrodes, an item of expense which has no counterpart in the ordinary blast furnace procedure.

Though the electric iron smelting processes may, therefore, make headway in localities where all the conditions favor the development, and where the price of ordinary pig iron is artificially increased by freight charges and protective duties, they are unlikely to undergo extension or development in other localities so long as cheap supplies of coal and coke are available.

A New Furring Plate

The Berger Mfg. Co., Canton, O., is now manufacturing a new type of furring plate. It is designed for use in the "Rib-Trus," a combination of furring plate and re-inforcing evolved by that company for application in concrete floors, walls, etc. The "Rib-Trus" furring plates are made of sheet steel and have a standard width of 24 inches, varying in length from 4 to 12 feet. Each plate is provided with five longitudinal ribs, which vary in height from ½ inch to 1 inch and are 6 inches apart on centers. A series of cross heads, 4 inches apart, run across the plate between each rib, while loops span them and run parallel with the ribs. The ribs on the plate act as beams and the plate thus has great rigidity, no support or centering being required on ordinary spans. The "Rib-Trus" has great tensile strength, the metal being split only parallel to the strain, while engaging lugs on the sides of the ribs provide extra holds for the concrete.

The chief advantages claimed for these furring plates are the ease and rapidity with which they may be placed and the fact that no false work is required. As neither nuts nor bolts are used, all the work is done from the top. Special clips fasten the plates to purlins. When the concrete is applied it engages with the loops; forming a perfect lock. The design of the plate produces a dovetail clinch on the underside which thoroughly re-inforces the concrete. This interlocking plan reduces the amount of cement drip to a minimum. When in position, these plates lie against the sheathing or studs, thus obviating the necessity of special furring strips. The truss may be used in all forms of concrete construction.

Induction Motor for Fan Service

The General Electric Co., Schenectady, N. Y., is now manufacturing a new line of polyphase, variable speed, exhaust sets having a simplified method of speed control, which are admirably adapted to ventilating service. The speed is controlled by shifting the rotor and shaft longitudinally so as to bring the windings of different characteristics into the magnetic field of the stator. The high speed winding consists of a squirrel cage, low resistance rotor, and an extension of the spider supports a cast iron ring which constitutes the low speed rotor. The motor frame is of the riveted frame type with field flanges having cast ears provided for attaching the supporting tripod. The shaft is extended at one end to permit mounting on the fan, while the opposite end has a thrust adjustable along the axis of the shaft. An adjusting rope wheel is mounted on the extended shaft and is threaded to an extended portion of the opposite fan shaft bearing. Maximum speed is secured by rotating the wheel by means of the adjusting rope, to the extreme right, the opposite limit of travel giving the minimum speed. A speed variation of 50 per cent may be obtained at high efficiency, the actual power taken from the line being reduced approximately in direct ratio to the decrease in speed. The fan is made in 18, 24, 30, 36 and 42-inch sizes.

Year of Activity in Development on Old Ranges

But Shipments of Ore Were Decreased—Unusual Tonnages in Stock Piles—Scarcity of Labor a Feature of the Year

By M P Youngs

MEASURED from the standpoint of ore shipments, the past year on the old ranges of the Lake Superior iron country has been comparatively dull; measured from the amount of exploratory, development and improvement work, the year has been one of large activity. More than the usual amount of ore—some millions of tons—already mined, is stored about the shafts, and production is below the normal. Yet it is doubtful whether more new mines were ever before being opened at one time or that prospecting was ever conducted on a more extensive scale at this season of the year.

A peculiar condition of the past season has been the scarcity of labor. Very few mines were operated at normal capacity, yet in various districts the number of men demanded was greater than the supply. This state of affairs may be traced in part to the activity in exploratory channels and in part to the exceptionally large amount of construction work. There was much new building, particularly on the Marquette range and in the Ironwood and Iron river districts of the Gogebic and Menominee ranges, respectively. An important project, now well advanced to completion, is the Cleveland Cliffs Iron Co.'s big water power plant on Carp river, near Marquette. A similar work is the installation at the Twin Falls of the Menominee river of the plant of the Peninsula Power Co. In the one case, electricity is to be conveyed as far as 30 miles, to supply mines in the Marquette district and, in the other, it is to be transmitted an even greater distance, to serve mines on the Menominee. A still more costly work has been the construction of the reinforced concrete ore dock of the Lake Superior & Ishpeming railroad at Marquette.

Crushing Plant Operations

Notwithstanding that the shipments from the company's mines were materially under those of past seasons, the output of the Steel Corporation's central crushing plant at Escanaba was the largest in its history. More than 200,000 tons of ore were treated. The crusher has a capacity of 500,000 tons a season and it is supplied both from the Marquette and Menominee ranges. An interesting work completed during the year was the removal of the bodies from the old cemetery at Negaunee. The ground is underlaid with ore which already is being mined by the Cleveland Cliffs Iron Co.

Marquette Range

The Cleveland Cliffs Co., the largest operator on the Marquette range, is operating on a less extensive scale than a year ago. The Imperial mine at Michigamme is closed, as is the Barnes property at Dexter. The Negaunee mine is being wrought on single shaft. The Northwestern property at Gwinn is idle and other properties in the same field are operating with reduced forces. The more important mines of the company are, however, employing good-sized crews, the Negaunee excepted, and the stock piles will be materially increased in size by spring. A big task completed by the company during the year was the work of giving the upper portion of the shaft at the Maas mine at Negaunee a lining of reinforced concrete. This lining is massive and extends down 192 feet. The Negaunee mine's new shaft also has been walled with concrete. This extends down more than 700 feet. The shaft has been given a steel equipment from top to bottom.

The most vigorous operations in the Marquette district the past season were conducted by the Breitung interests. The Cleveland Cliffs company's Lucy mine at Negaunee has been out of commission since early in the summer. So also have the Republic Iron & Steel Co.'s Cambria and Hartford properties. The Lilly mine of the Republic company, the Regent group of the Steel Corporation and the rolling mill property of the Jones & Laughlin Steel Co. are on the active list. An important development at Negaunee has been the pooling of the interests of the Cleveland Cliffs and Breitung companies in much-litigated lands and the organization of two new companies.

The Volunteer Ore Co., of T. F. Cole and associates, is developing the Volunteer mine, in the Cascade district, five miles south of Negaunee. Two miles east, the Heidelbach banking interests of New York City have started the exploration of seven forties in section 26, 47-26. In the Gwinn district, 20 miles south of Negaunee, the Cleveland Cliffs company is sinking two concrete shafts at the Cyr property. Shafts of like nature are completed at the Smith, Kidder and Northwestern.

The Steel Corporation has been operating its hard ore properties and the section 16 and hematite mines at Ishpeming only four days a week. Its section 21 mine is practically out of commission. The Jones & Laughlin Lake Angeline mine is operating quietly, conserving the ore for use as a mix with the fine-grained Mesabi product. The company is diamond drilling its lands near Ishpeming. West of Ishpeming, the Cleveland Cliffs company is opening the North Lake mine. In the same region is M. A. Hanna & Co.'s American mine, once poorly thought of, but now developing into a fine property. Adjoining on the west is a 200-acre tract under lease to the Hanna interests. This tract is of proved mineral wealth.

Developing the Kloman

As for many years, the Cambria Steel Co.'s Republic mine has been the only producer in the Republic field the past season. However, the John T. Jones furnace interests are developing the old Kloman. The Steel Corporation is exploring the Riverside. Fourteen hundred acres west of Republic have passed to the control of the Forty-Six Thirty Mineral Land Co., and have been opened to lease. The Steel Corporation's Champion mine at Beacon has been sunk to the 2,100-foot level. Little more than exploratory work is being done. With the exception of exploratory work at the Catherine company's property, no work is being

done in the Michigamme district, the Imperial, Portland and Ohio mines all being closed.

Much of the activity on the Menominee range the past season has centered in the Iron River district. A score of mining or exploratory companies are at work, a number of new mines are being opened and 20 or more diamond drills are in commission. The latest entrants have been the Escanaba Development Co., Iron River Ore Co. and Escanaba Exploring & Development Co. The Wickwire Mining Co. entered the district six months ago and already has developed one shipper. An important work of the year was sinking a concrete shaft at Rogers, Brown & Co.'s Rogers mine, destined to become one of the most important mines of the district.

The Spring Valley Mining Co. has been operating its Zimmerman property to capacity. It is opening a new mine on the adjoining Kinney tract. The New York State Steel Co. is developing the Gleason and the Goodman. In the same vicinity, the Jones & Laughlin Co. is opening a large deposit in section 15, 43-35. The Republic Iron & Steel Co. is testing the Sherwood property. The Ladenberg-Thallman interests are developing the Bates mine.

Operations Suspended

Operations at the Baker mine at Stambaugh were suspended by Corrigan, McKinney & Co., after the expenditure of several hundred thousand dollars. Oglebay, Norton & Co.'s Berkshire mine is out of commission, its twin property — the Chatham — meanwhile continuing in operation. Oglebay, Norton & Co. have taken over the old Riverton, previously operated by the Steel Corporation, and are developing the area between that property and the Chatham. Pickands, Mather & Co.'s Caspian mine was out of commission six months during the season, but has recently resumed work. The company is developing the nearby Fogarty mine and the Bengal property, adjoining Stambaugh village. The Huron Mining Co.'s Youngs mine at Palatka is operating on a reduced scale.

Production in the Crystal Falls district of the Menominee has been small the past year, capacity considered, and not all the mines have been in service, notably members of the Corrigan-McKinney group. Exploration has been exceptionally active, however, and in general has been productive of excellent results.

The most successful exploratory work probably has been that of M. A. Hanna & Co. on the Carpenter lands in section 31, 43-32. The deposit found is of large extent and the ore of exceptional quality. The Hanna interests also have located a large ore body at the Monongahela property, in section 36, 43-33. The deposit is hundreds of feet in thickness. In section 19, 43-32, the Hanna interests have another new deposit. This is at the Ravenna, now being developed. Still another important mine is that of the Nevada Land Co., of the Longyear interests, in section 13, 42-33.

Successful Exploring

Corrigan, McKinney & Co. have met with success in exploring the Ramsey & Jones property in section 21, 43-32, north of their Great Western mine. Ore has been found. The Breitung interests have been drilling the lot 9 property, in 43-32. This work is suspended for the winter. Pickands, Mather & Co. appear to have a valuable possession in the Warner property, in section 9, 44-33. Rogers, Brown & Co. are at work in section 33, 44-33. The Steel Corporation controls a tract in section 36, 43-33, west of the big Carpenter find, and will give it a thorough test.

The Huron mining interests some time ago resumed operations at the MacDonald property at Crystal Falls.

The Cuyahoga Iron Co. has started the development of the Victoria property, in section 22, 43-32. The International Harvester Co. is testing the lot 3 property. Opening its fine new shaft has been the principal work at the Bristol mine of Oglebay, Norton & Co. Corrigan, McKinney & Co.'s group has been operated quietly and enters the new year with much ore in stock. The Steel Corporation's Mansfield mine also has been wrought at less than capacity, Pickands, Mather & Co.'s Hemlock has sent out practically the average output.

The Steel Corporation has operated its Chapin and Aragon mines at Iron Mountain and Norway, respectively, on a reduced scale most of the year, and only on the day shift. Important improvement work has been instituted at the Chapin—the Menominee range's largest mine. The Pewabic company's mine at Iron Mountain has been operated at practically the normal basis. The Dessau company's Millie, idle in 1910, has made a small production.

The Cambria Steel Co. has been employing reduced forces at its Penn group, although operations at the Norway mine were resumed toward the close of the shipping season. The Loretto company's property has been wrought on a four-day-a-week scale most of the year. At Commonwealth, Oglebay, Norton & Co.'s Buckeye mine is closed. Ladenberg, Thallman & Co.'s Florence mine was inactive four months, but is now employing 100 men and has shipped the bulk of its stock pile. The Rogers-Brown company's Munro mine at Norway, an open-cut proposition, was active for a time during the summer. Pickands, Mather & Co.'s Vivian property at Quinnesec is idle and has still 125,000 tons of ore in stock. The Antoine Ore Co.'s Traders mine was in commission the latter portion of the season. The big open pit, containing 100,800,000 gallons of water, was unwatered in the remarkably short time of ten days.

Gogebic Range

As in the other districts, production on the Gogebic range has been curtailed. The largest mines have been operated on single shift and on short time, including those of the Steel Corporation and the Schlesinger interests. Much development work has been done, however, and there has been important success in exploration.

Exploration at depth at the Schlesinger company's Anvil mine has located an important deposit. The same interests have leased two "forties" north of the Palms mine. The No. 6 shaft at the Steel Corporation's Tilden property is opening a large deposit, after drilling and sinking for five years. The Jones & Laughlin company has been doing some exploratory work at the Jack Pot property, just west of the Lake Superior Iron & Chemical Co.'s Yale mine, which is developing a large and deep-lying deposit. The Pence and Snyder property, at the western end of the range, also is being tested by Jones & Laughlin. Oglebay, Norton & Co.'s Ottawa mine, west of Hurley, has been idle the better part of the year.

The December number of *American Vanadium Facts*, published by the American Vanadium Co., Pittsburgh, contains an exceedingly interesting article, entitled "Vanadium Steel in Machinery Equipment," for rock drills; other articles treat of the use of vanadium in locomotive frames, gears, etc.

The Iroquois Iron Co.'s New Blast Furnaces

A Description of the Two 300-Ton Stacks Recently Completed at South Chicago Which Are Driven by Turbo Blowers

THE growing importance of Chicago as a center for the production of merchant pig iron will be further augmented early this year by blowing in one of the two 300-ton furnaces at the new plant of the Iroquois Iron Co., which has been completed recently. At present there are four merchant stacks in the Chicago district with an annual capacity of 400,000 tons. To this the two new furnaces will add 200,000 tons, increasing the available capacity of the district by 55 per cent. The Iroquois Iron Co. acquired its first furnace, which is 80 feet high and 17½ feet in diameter, at Ninety-fifth street and the Calumet river, South Chicago, in 1890. In 1900 the second furnace, B, 85 feet high and 18½ feet in diameter, was erected, thus doubling the capacity of the plant. The two new furnaces recently completed, designated C and D respectively, will again double the output of the company's works.

Location of the New Plant

The new plant is situated about 1,000 yards northeast of the old furnaces on the shores of Lake Michigan. It consists of two blast furnaces having a daily capacity of 300 tons each, together with eight stoves, a pig casting machine, a power plant and extensive ore-handling facilities. The property includes 78 acres with a frontage of 1,700 feet on the lake and 2,000 feet on the river. It is situated on the site of an old government dock which formed the south pierhead line at the mouth of the Calumet river and extends out into the lake about 2,000 feet to the 24-foot depth. Rogers, Brown & Co. are the selling agents for the entire output of the Iroquois Iron Co.'s furnaces.

Fig. 19 shows the general layout of the property, indicating the foundations for the ore bins, furnaces, stoves, power plant and pig casting machine and showing the arrangement of the tracks serving the plant. Fig. 3 is a cross-section of the plant on a north and south line through the center.

The ore yard, which is 1,200 feet long and 284 feet wide, occupies the north portion of the site, fronting on the Calumet river, thus affording ample docking facilities for ore steamers. The larry bins are constructed along the southern edge of the ore yard, as indicated in Fig. 19. The two furnaces are immediately south of the larry bins; their common center line

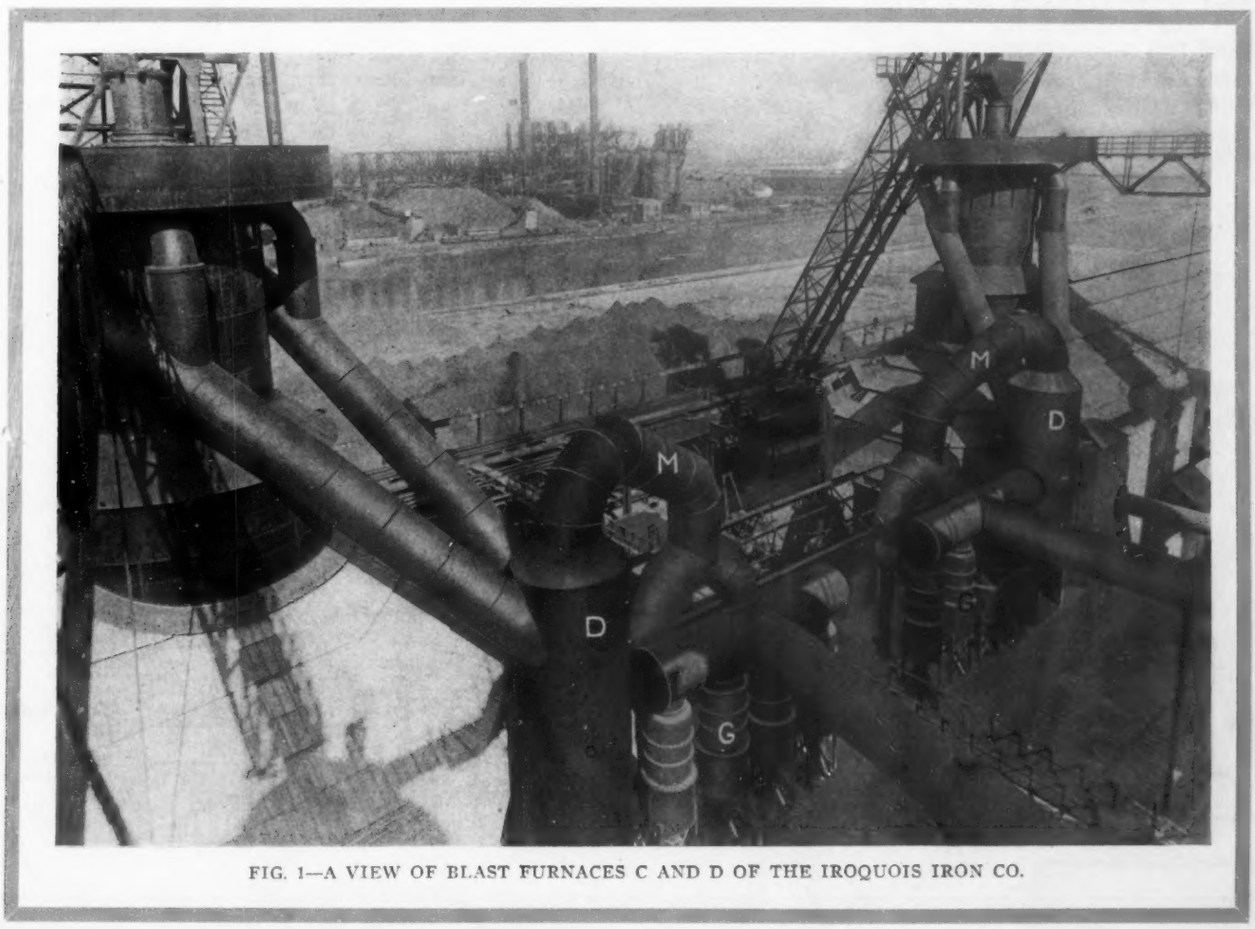


FIG. 1—A VIEW OF BLAST FURNACES C AND D OF THE IROQUOIS IRON CO.

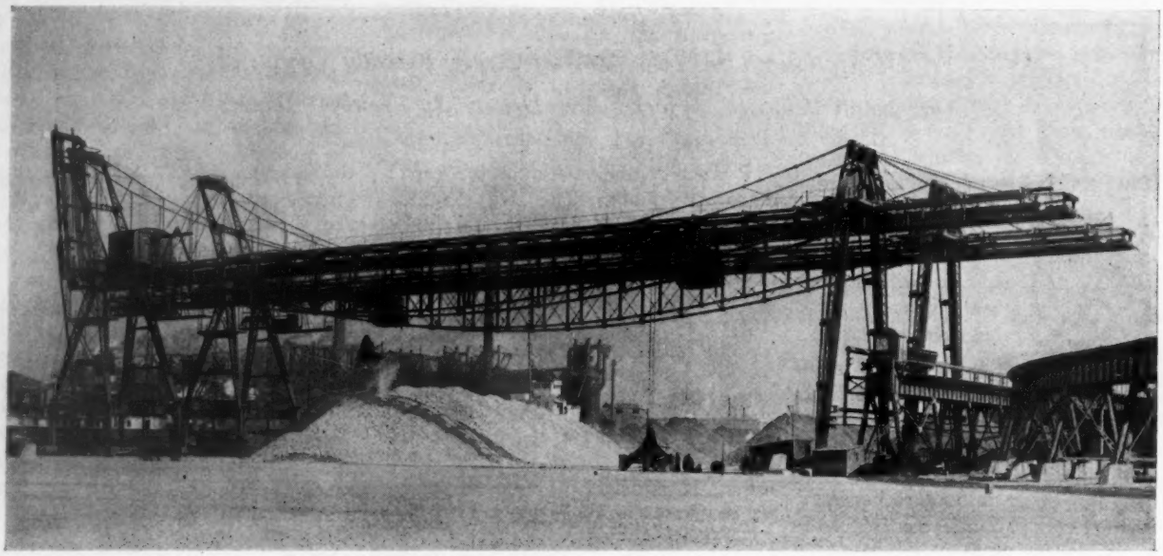


FIG. 2—THE BROWN HOIST ORE BRIDGES

runs east and west and is 437 feet south of the dock line. The westerly stack is known as C furnace and the easterly one as D furnace. The two cast houses extend from opposite sides of the furnaces in a general east and west direction. The eight stoves are immediately south of the furnaces, their common center line being 106 feet from the center line joining the stacks. The pig casting machine is situated at the southern extremity of the works and the boiler house and power plant are between it and the line of stoves. The center line of the pig casting house is 909 feet south of the pier-head line.

As indicated in Fig. 19, the railway tracks enter the plant on the southwest side and each department is provided with ample switching facilities. The various spurs to the bins, furnaces, power plant, pig casting machine, etc., are connected with a single main stem track on the east to facilitate train movements.

The ore dock is 1,200 feet long and is built 52 feet back of the former government pier face so as to permit ore boats to lie alongside without obstructing the channel. The normal depth of water in front of the dock is 21 feet. The construction of the

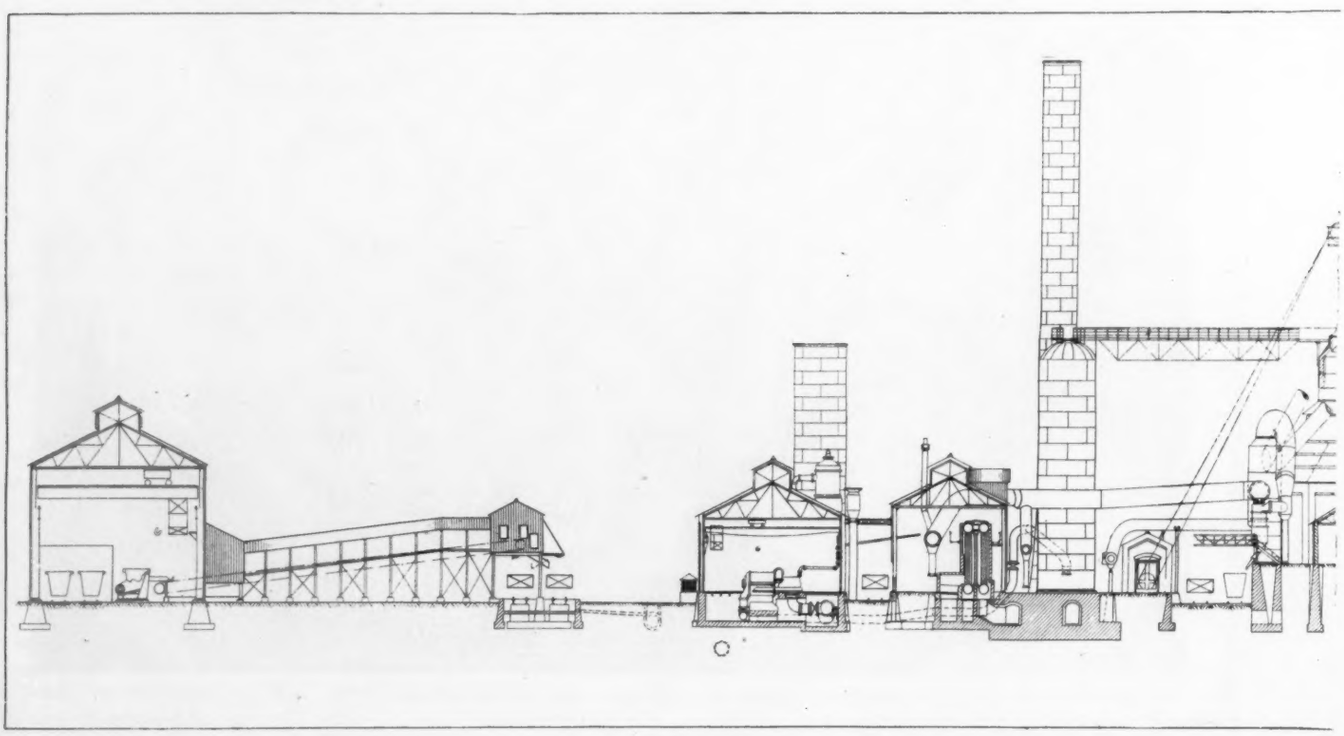


FIG. 3—A SECTION THROUGH THE IROQUOIS IRON CO.'S

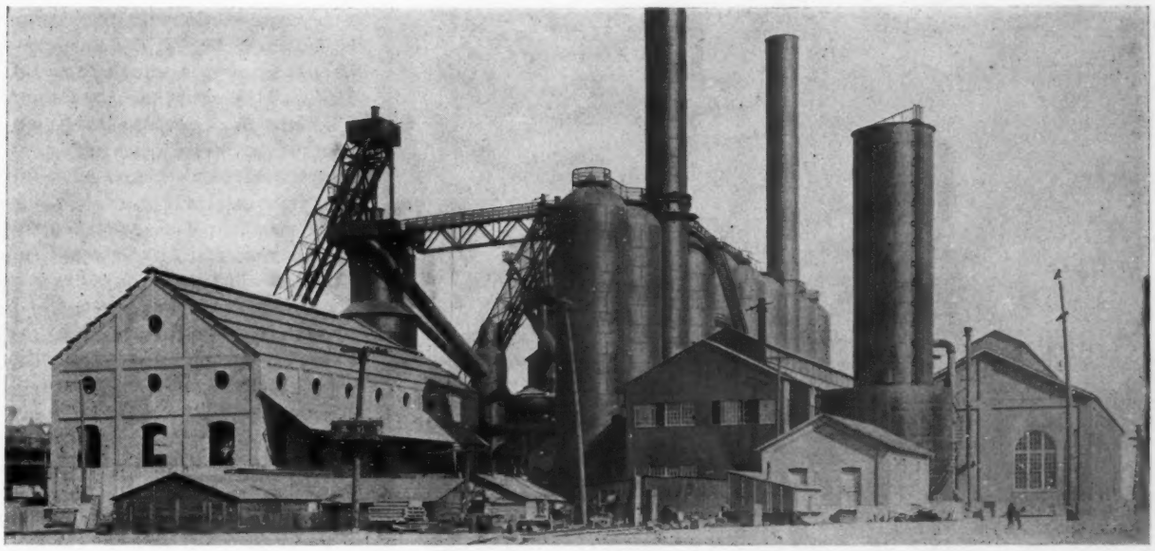
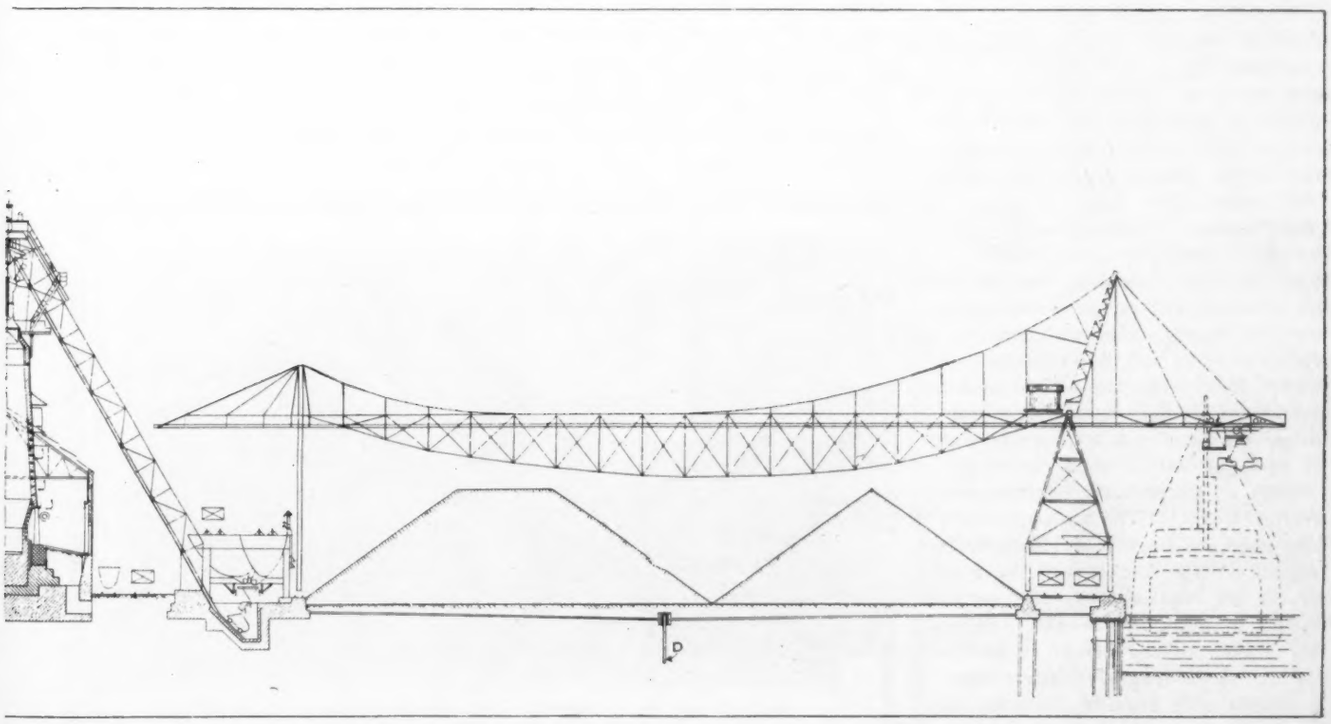


FIG. 4—GENERAL VIEW OF THE PLANT, SHOWING KENNICOTT WATER-SOFTENING APPARATUS

dock and the ore storage yard is indicated in Fig. 3. The dock proper consists of two close-driven, rock-filled, pile piers, 32 feet apart, capped with concrete. The outer pier, facing the river, consists of three rows of piles and the inner has only two rows. The two parallel concrete monoliths which cap the piles are tied together by 2-inch steel rods, the concrete work being reinforced further by eighteen 1-inch square twisted bars, distributed longitudinally. Through the center of the ore yard is a deadman, *D*, Fig. 3, which is tied to the piers at the north and the larry bin foundations at the south by 2-inch diameter steel rods, thus preventing any spreading of the ore bridge track due to the weight of the stock piles.

The ore yard has been filled to a depth of 4 feet with granulated slag, obtained from the old furnaces of the Iroquois Iron Co. The yard has a capacity of approximately 600,000 tons of iron ore, the effective height between the ore bridges and the ground being about 44 feet.

For unloading vessels and handling the ore to and from the stock piles, the yard is equipped with two bridge tramways, Fig. 2, of 7½ tons capacity each, furnished by the Brown Hoisting Machinery Co., Cleveland. Each bridge is supported on a pier



BLAST FURNACE PLANT, ON THE NORTH AND SOUTH LINE

FIG. 5—GENERAL VIEW OF THE FURNACES AND SKIP BRIDGES

construction at the front end, and on an A-shape shear leg at the rear. The pier operates on a 32-foot gage track and the shear leg travels on a 3-foot track. The bridge is operated by motors, the power being delivered to the tracks through shafts and gears. The motors are placed in a small motor house on top of the pier. The bridge is 300 feet long between the pier and the shear leg. At the rear it is fitted with a cantilever projection, 51 feet, 9 inches long and at the front there is an apron 84 feet, 8½ inches long. This apron is suspended on hinges so that it can be raised to allow the boat to dock. Each bridge is equipped with a trolley runway on which a Brownhoist electric man-trolley travels. The trolley carries a two-rope ore bucket of 110 cubic feet capacity. The bucket and the trolley travel are controlled by the operator riding in the trolley cage. The trolley travel on the bridge is 398 feet, 11 inches in length. Each bridge is equipped with a guide chute for loading the material into freight cars stationed between the pier legs. The hoisting speed of the bucket, at full load, is 225 feet per minute and the trolley travel along the bridge, with full load, 900 to 1,000 feet per minute. The bridge travels with its capacity load at speeds from 50 to 75 feet per minute. The overall spread of the bucket is approximately 17½ feet.

A cross-section of the larry bins is shown in Fig. 3; the larry cars run on a suspended track beneath the bins. The coke and ore bins are parallel, the former being on the south side. The construction of the larry track and chutes beneath the bins is shown in Fig. 7. The bins are built of steel plate of the Brown parabolic type and are erected in two sets, one for each of the furnaces. Each set consists of eight panels about 14 feet long. They have a capacity for 24 hours operation of the furnaces. The two rows of bins in each set are served by parallel standard gage tracks which are laid along the top. These tracks are connected to the yard system by an inclined, curved steel trestle built on a radius of 420 feet, as indicated in Fig. 19. The grade of the track on the trestle is 1¾ per cent. Although the ore bridges are arranged so that the buckets could drop their load directly into the bins, a suitable Brown drop-bottom, transfer car is also provided for distributing the ore and limestone to the various panels. It has a four-compartment hopper mounted on a structural steel frame and is electrically-driven and controlled completely from the operator's cage, situated at one end.

The ore bins have a capacity of 13 tons per lineal foot; the coke bins have a capacity of 4 tons and the limestone bins, 9 tons per lineal foot. All the steel members of the bins, the deck spans connecting the two units and the steel trestles, are designed with a factor of safety of five for live loads and four for dead and wind loads. The shock due to loading ore, coke and steel into the bins is taken

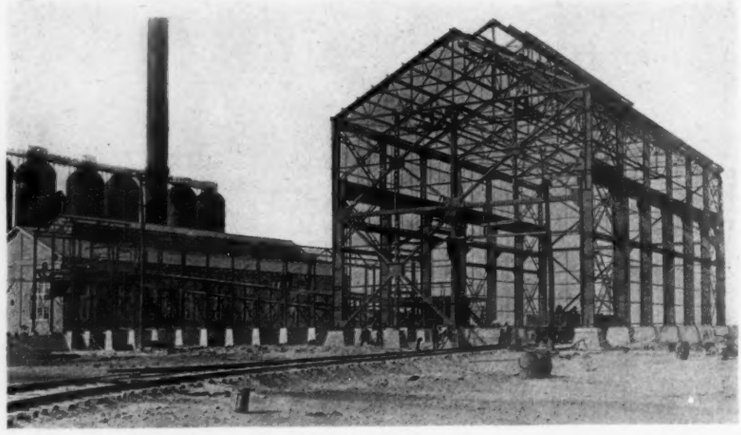


FIG. 6—THE PIG CASTING MACHINE IN COURSE OF ERECTION

into consideration in calculating the live load.

Each panel length of ore and limestone bins is equipped with two bottom spouts and gates and each coke bin panel has one spout and gate. The driving shaft and gearing for opening the gates are hung from the bottom of the bins. The opening of the gate is controlled from the larry operating in the tunnel beneath the bins. The transfer subway beneath the bins is unusually light and commodious and is enclosed in permanent brick walls throughout its entire length. Windows are placed at frequent intervals. In this tunnel the three electric larries are operated in transferring materials from the bins to skip cars. The larry track is suspended from the bottom of the bins. Each larry has a bucket with a capacity of 120 cubic feet, which is carried on a special weighing mechanism. The balance levers are directly in front of the driver so that he may readily watch the quantity of material taken from the bin. The larry is electrically-driven by a 20-horsepower car motor, through a train of gearing, current being taken from a convenient trolley. The traveling speed with a full load is from 600 to 900 feet per minute. Another 20-horsepower car motor is installed on the larry for operating the foot gates of the bins and each motor has a separate controller. Projecting down from each bin gate is a key through which a mechanical connection is made between the larry motor and the gearing above. A socket located on the larry may be raised or lowered by levers from the driver's position to fit over this key. One man, therefore, on each larry controls the complete transfer of material without moving from his position.

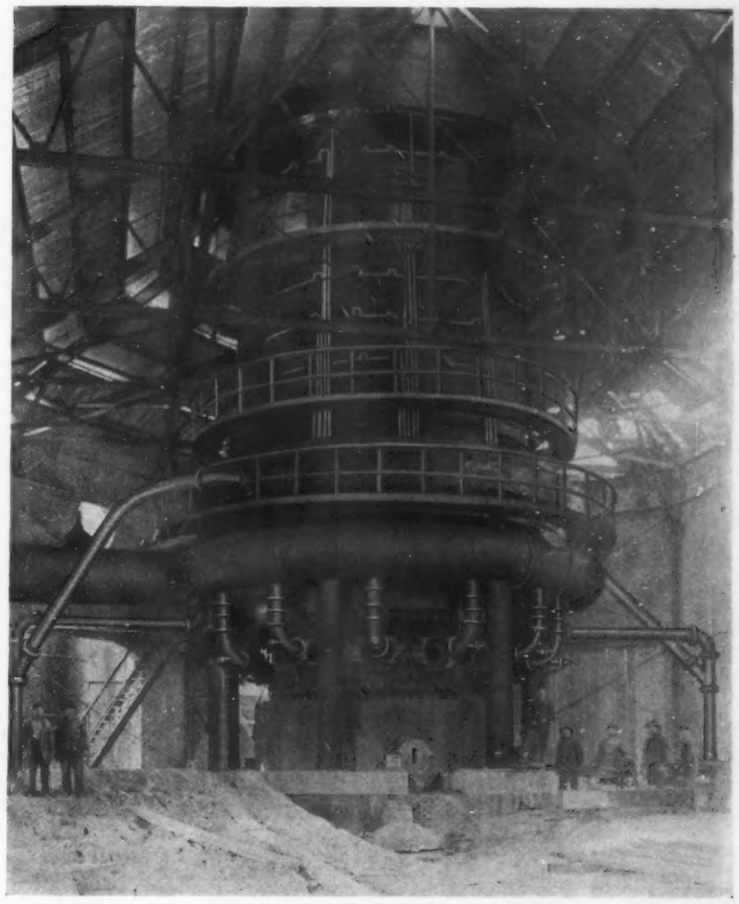


FIG. 8—BOSH OF FURNACE D

The two blast furnaces are built from designs prepared by Julian Kennedy, Pittsburgh. One is arranged for making machine-cast pig exclusively and the other, D furnace, can be employed for making either machine or sand cast pigs. The stacks are duplicates, each one having an approximate capacity of 300 tons per day. The lines of the furnace are shown in Fig. 12; Fig. 16 is a tuyere plan; Fig. 5 shows the skip bridges and furnace tops from the northwest and Fig. 8 shows the lower portion of D furnace as seen from inside the cast house. Each stack is 85 feet 4½ inches high and 21 feet in diameter at the bosh. The furnaces rest on monolithic concrete foundations which in turn are supported by closely-driven clusters of piles. The concrete foundation is capped with a layer of second quality fire brick surmounted in turn by a course of hearth blocks 12 feet in thickness, as indicated in Fig. 12. The hearth-blocks are 18 x 9 x 4½ inches in size. The hearth is 14 feet in diameter. The center line of the iron notch is 14 inches; the center line of the cinder notch 5 feet 2 inches, and the center line of the tuyeres is 8 feet 8 inches above the hearth level.

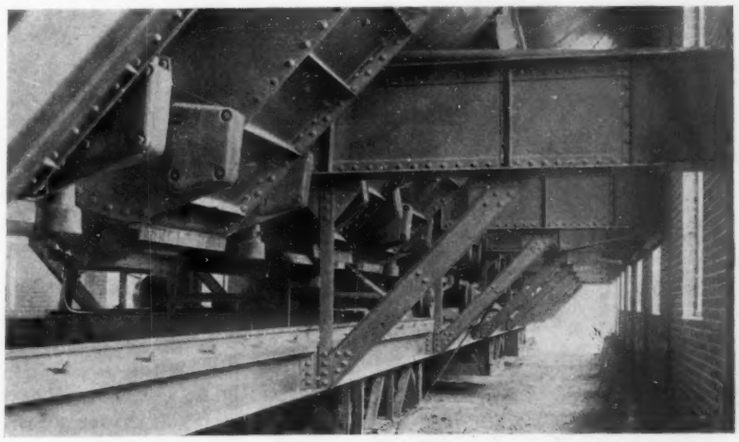


FIG. 7—THE ELECTRIC LARRIES UNDERNEATH THE ORE BINS

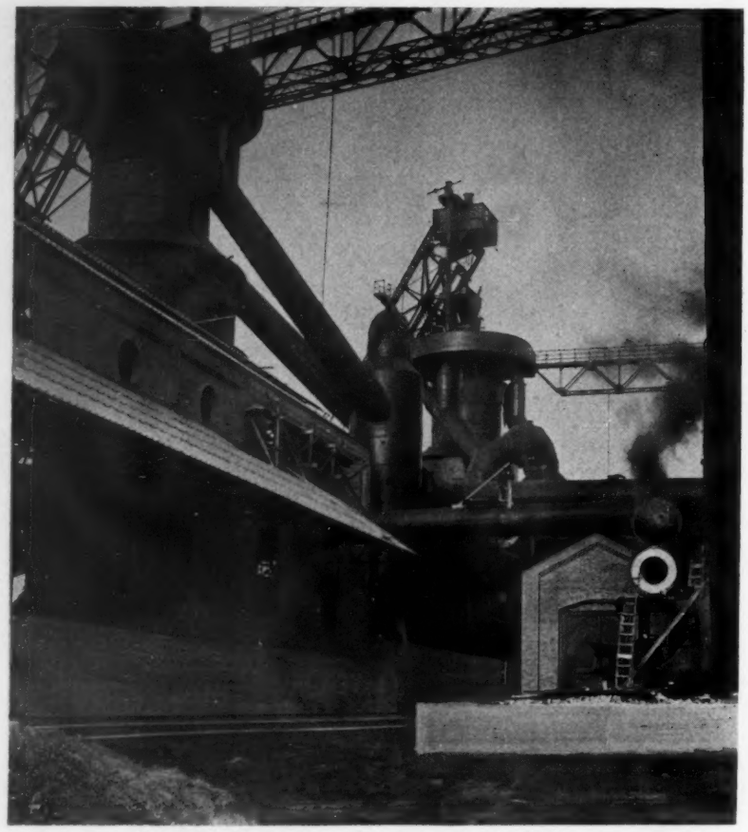


FIG. 9—ANOTHER VIEW OF THE FURNACES C AND D

Each furnace is equipped with 12 tuyeres of standard design connected to a bustle pipe 24 inches inside diameter. The fire brick lining in this pipe is 9 inches in thickness, making the outside diameter 42 inches. The details of the hearth, tuyeres, blow pipe, leg pipe and bustle pipe are shown in Fig. 11. The extreme bosh diameter, 21 feet, occurs at a point 21 feet 3 inches above the hearth level. The material for the lining of one furnace was furnished by the Harbison-Walker Refractories Co., Pittsburgh, and the lining of the other by the Olive-Hill Fire Brick Co. The top brick and inwall brick are 5 inches in thickness, the bosh brick are 4⅛ inches except in front of plates where they are 3 inches thick, and the hearth is laid with 2½-inch brick. The side wall lining just above the mantle is 16½ inches thick; above the cooling plates it is 19½ inches and at the top, 24 inches.

The mantle rests on six cast iron columns each 20½ feet in length, which are supported on cast iron bases 24 inches high, embedded in concrete.

The hearth is inclosed in cast iron cooling plates 4½ inches thick, surrounded by a 1½-inch steel plate jacket and neither the hearth nor shell are cooled externally. In the boshes are eight rows of cooling blocks, there being 22 blocks in the first row, 12 in the second and third and 18 in the upper rows. In the side wall lining, for a height of 27 feet above the boshes are nine rows of cooling plates and above this the walls are not water-cooled. Openings are cut in the shell so that each cool-

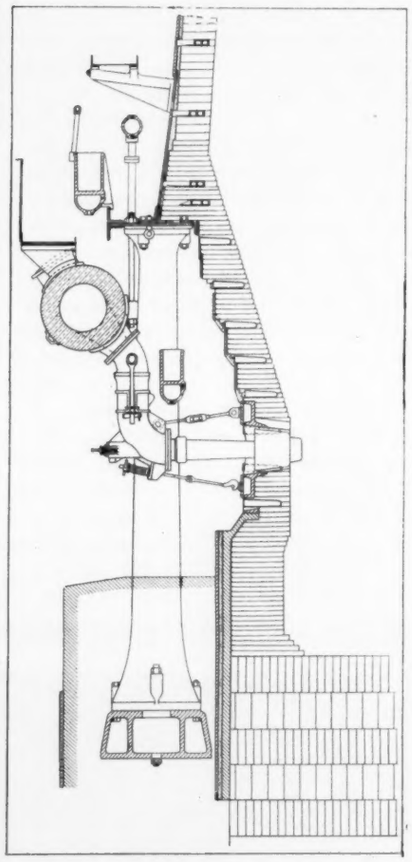


FIG. 11—A SECTION OF THE FURNACE BOSH

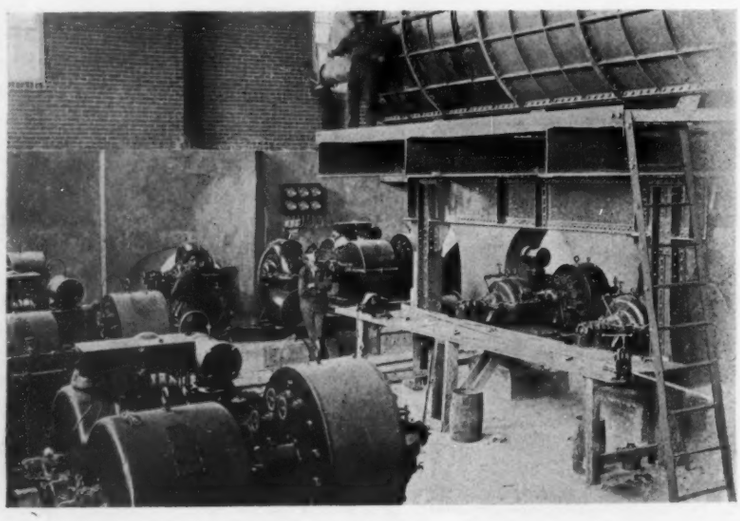


FIG. 10—THE PUMP WELL IN THE POWER PLANT

ing block may easily be removed. For handling the cooling blocks conveniently, galleries are built around the furnace, as indicated in Fig. 12. They are provided with steel canopies which protect the men at their work. Hot air pipes for the prevention of freezing are carried under the canopies.

The furnaces have closed tops of the standard Kennedy type, the details of which are shown in Fig. 18. There are no explosion doors, as it is claimed they are unnecessary and only serve to allow the escape of stock during the slips. The small bell is 3 feet, 10 inches in diameter and the large bell 10 feet, 2 inches. The lining of the furnace just below the bell, where the charge strikes, is protected by heavy plates 6½ feet high, cast in segments, making a throat 14 feet in diameter. The gases

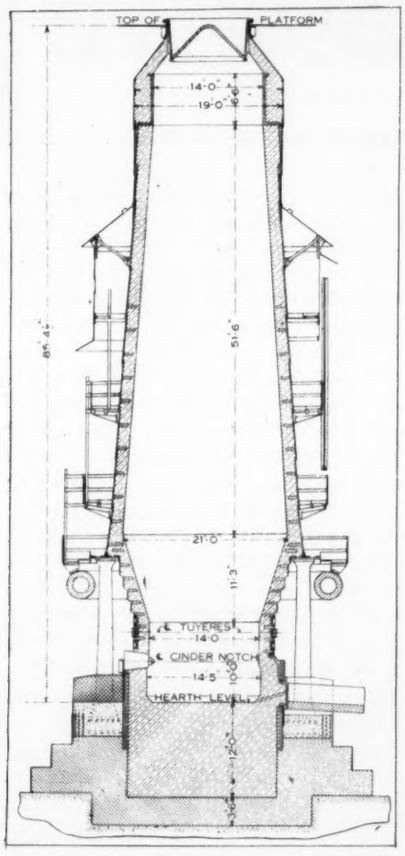


FIG. 12—SECTION THROUGH ONE OF THE BLAST FURNACES

are taken off from four openings in the top, each opening being 3 feet in diameter, enlarging at the second elbow to 3 feet, 6 inches.

The skip bridge is a standard two-truss structure, carrying double tracks side by side, designed for balanced operation. The skip buckets are of the self-dumping variety with the bale attached at the rear; the rear wheels being provided with wide treads to engage the outer rails in dumping.

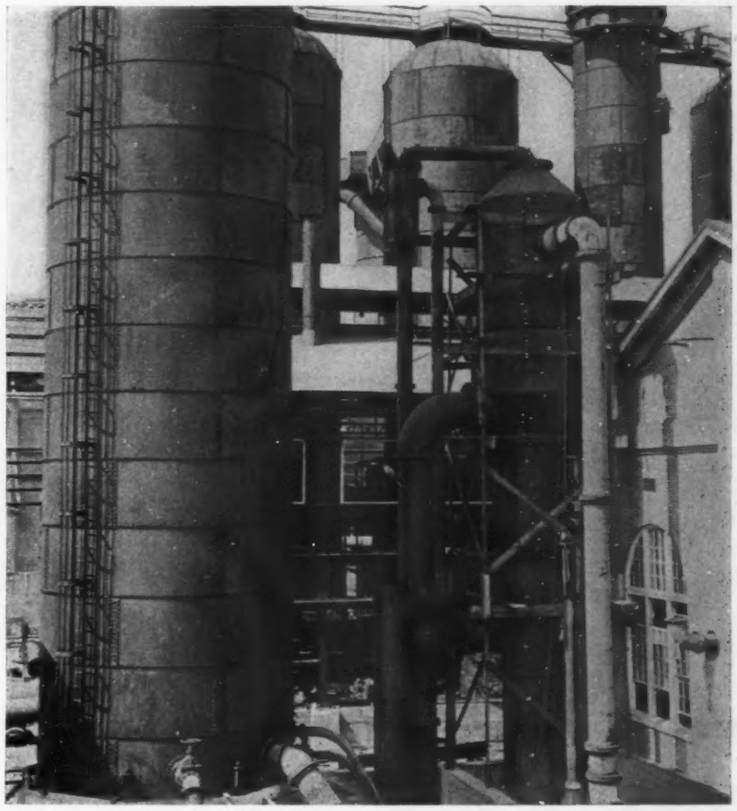


FIG. 13—STAND PIPE AND JET CONDENSERS

The skips are operated in balance by a steam-driven hoist, furnished by the Otis Elevator Co. The hoist house is located between the furnace and stoves, as indicated at *H*, Fig. 17.

The details of the gas connections and dust collectors are shown clearly in Fig. 1. The four openings in the top of the furnace unite in two downcomers, each 4 feet 9 inches in diam-

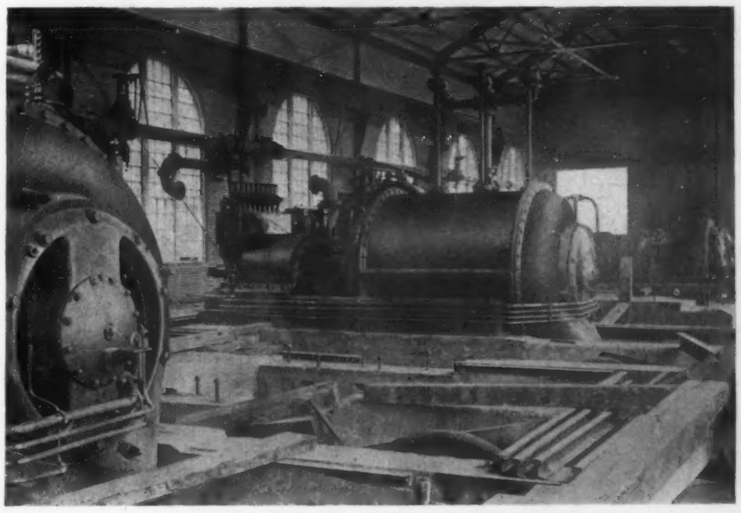


FIG. 14—A VIEW OF ONE OF THE TURBO-BLOWERS

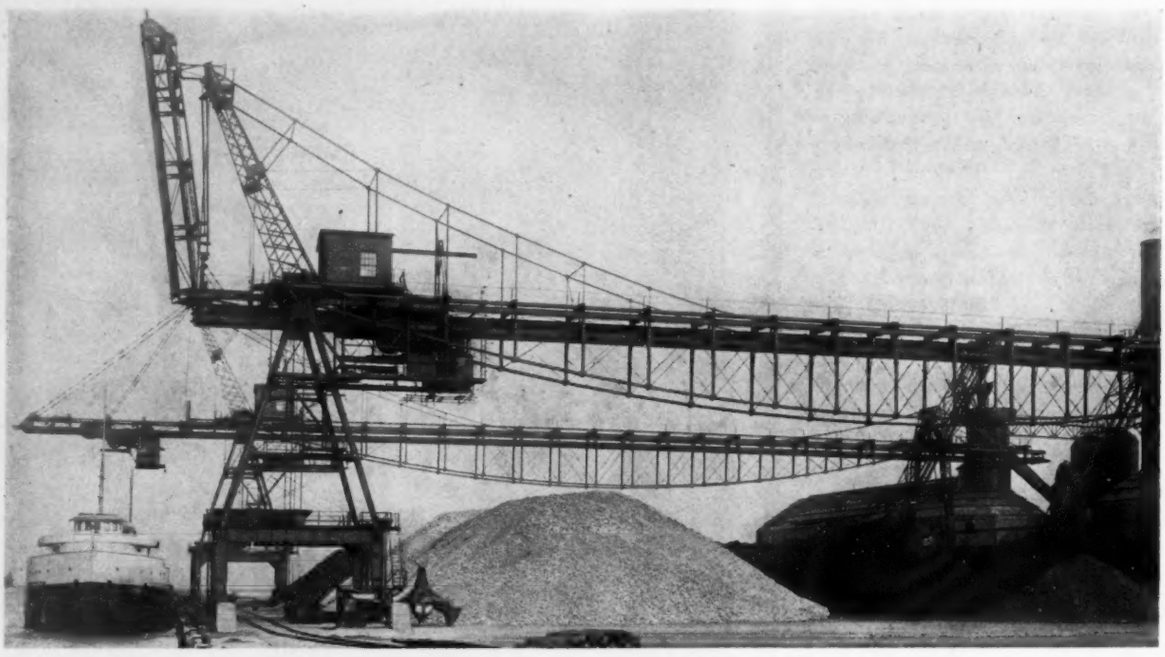


FIG. 15—THE ORE DOCK FRONTING ON THE CALUMET RIVER

eter. The gases in the downcomer have a velocity of about 30 feet per second and discharge into the side of the first dust catcher. This dust catcher, *D*, Fig. 1, is 12½ feet in diameter and 35 feet high. The gases pass out of the top through a main, *M*, Fig. 1, 6 feet, 3 inches in diameter to the four centrifugal gas cleaners, *G*. They are spaced 9 feet center to center and 13 feet, 6 inches to one side of the center line between the furnaces. The gas, on entering the cleaners on the side at the top, descends in the annular space formed by the shell and the central uptake. A rapid, revolving motion is given the gases by a number of curved radial vanes causing a separation of the dust from the gases by centrifugal action. The dust then is collected at the bottom and is spouted directly into cars. Each group of four cleaners has a riveted manifold across the top, which connects with mains 6 feet, 3 inches long, leading to the stoves and power plant.

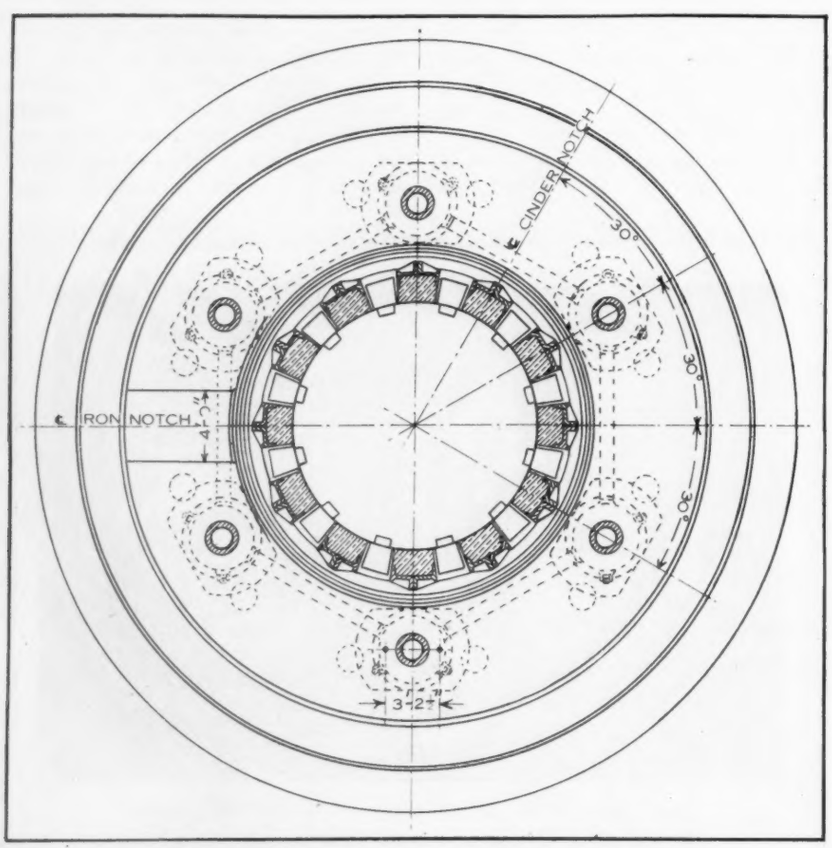


FIG. 16—THE TUYERE PLAN OF THE BLAST FURNACES

Each furnace is equipped with four Kennedy central combustion, two-pass stoves, Fig. 17, 22 feet in diameter by 96 feet, 4½ inches in height. Two self-supporting steel chimneys, 13 feet in diameter and 200 feet high, are provided. Each stove has two chimney valves. The hot blast valve is of the standard mushroom type, water-cooled, with a water-cooled seat. During the erection of the plant the stacks were each equipped with derricks mounted on rollers so that they could swing through 360 degrees, serving both the furnaces and the power plant, their radius of operation being 125 feet. The stack flues underground are double and the back flue is also used to take off the

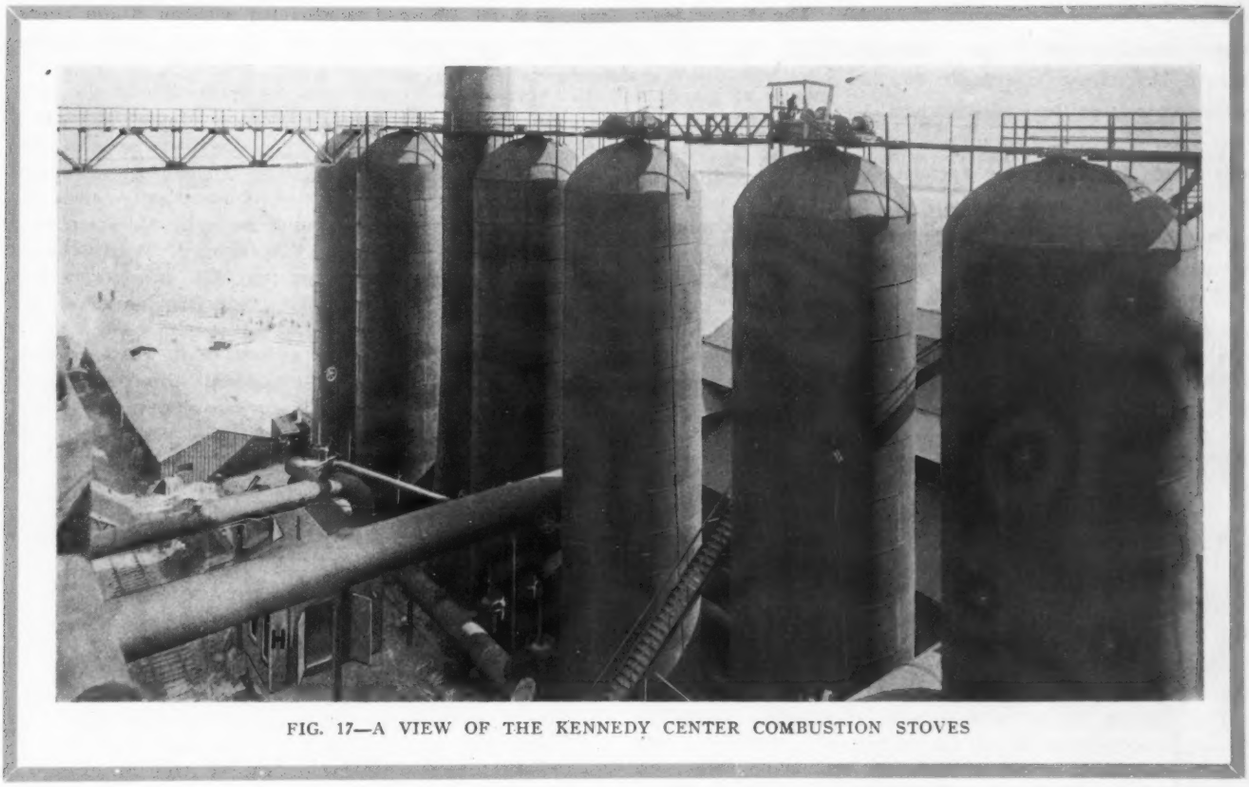


FIG. 17—A VIEW OF THE KENNEDY CENTER COMBUSTION STOVES

products of combustion from the boilers.

A spur track extends along the south side of the cast house so that either furnace can deliver metal into ladle cars; D furnace is provided with a sand bed 250 feet long and 69 feet wide. At the east end of the cast house for the furnace a Brown hydraulic pig breaker is installed over a depressed track, so arranged that the broken pigs drop directly into railroad cars. The cast house is equipped with a 5-ton electric traveling crane for handling sows and pigs from the sand bed to the breaker. This crane was installed by the Brown Hoisting Machinery Co.

One of the most interesting features of the plant is the power station, owing to the fact that General Electric turbo blowers, Fig. 14, of the type now in use at the Oxford furnace, New Jersey, and the Port Henry furnace, New York, are installed. There are three blowers in all, one for each furnace and a spare one, each driven by a Curtis steam turbine rated to develop 2,900-horsepower. The blowers are designed to deliver 44,000 cubic feet of air per minute each, at a maximum pressure of 30 pounds per square inch. The steam pressure is 150 pounds per square inch and the units operate condensing at 3,600 revolutions per minute. The volume of air to be delivered by the turbo blowers is automatically controlled by means of a regulator in the air suction which controls the quantity of air admitted to the blower vanes. The turbines exhaust into a Helander barometric condenser provided with two Mesta dry air pumps, having steam cylinders, 14 x 36 inches and air cylinders, 36 x 36 inches.

Steam for the power plant is generated in a battery of 13 Rust vertical water tube boilers rated at 550 horsepower each. They are equipped to burn blast furnace gas under ordinary conditions, but may also be hand-fired with coal. The fire under each boiler may be independently controlled.

The power house is a steel frame and brick structure, 220 feet long and 55 feet wide. The auxiliary equipment in the power plant includes two Epping-Carpenter, 19 x 34 x 4½-inch

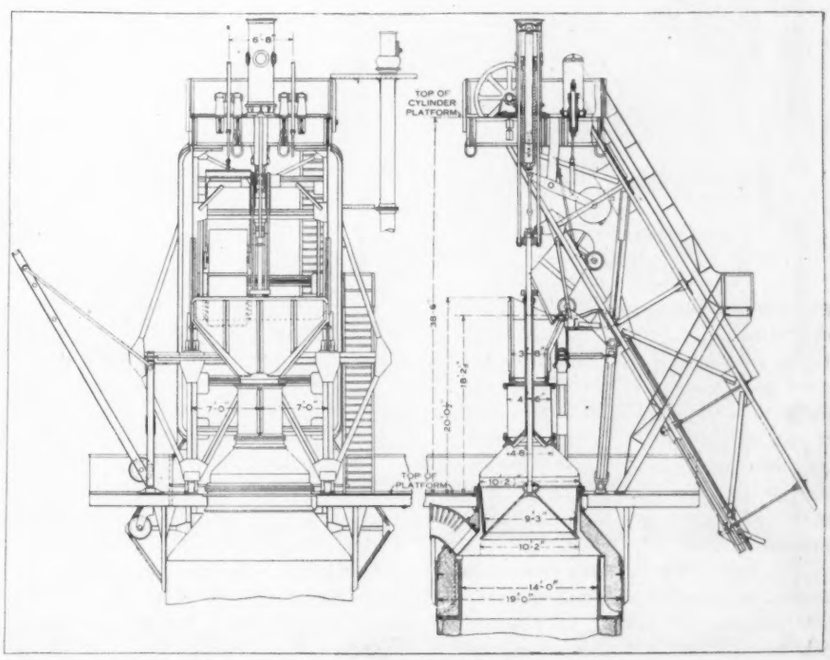


FIG. 18—DETAILS OF THE FURNACE TOP

hydraulic pumps for operating the pig breaker located in the cast house of furnace D. Water is brought to the power house from the intake in the Calumet river through a 60-inch, cast iron pipe and the outgoing return is through a 60-inch brick conduit.

The service and cooling water pumps as well as the condenser and feed water pumps are of the De Laval steam-turbine, centrifugal type. Three sets are used for general service. Two of these are connected in series, and they are rated to deliver 7,000 gallons per minute against a head of 110 feet, operating at a speed of 885 revolutions per minute. The third set is used as a spare set and is connected up with a gate valve so arranged that it can be operated in either series or parallel and be cut in on either the service or condenser line. Its rating in series is the same as the other two and in parallel it is limited to a head of 55 feet. The fourth set is connected in parallel and will deliver 14,000 gallons per minute at a speed of 900 revolutions per minute against a head of 35 feet.

The boiler feed pumps consist of three centrifugal pumps, turbine-driven, rated to deliver 635 gallons per minute at a speed of 2,850 revolutions per minute, against a pressure equivalent to a head of 465 feet or approximately 200 pounds. The hydraulic pumps and accumulator for operating the furnace bells are also placed in this pit. These are of the Smith-Vaile type, built by the Platt Iron Works, 10 x 2½ x 12 inches. The accumulator was furnished by R. D. Wood & Co., Philadelphia.

The electric plant consists of two 600-kilowatt turbo-generators for the ore bridge and larry operation and a motor generator set for direct current service. The latter consists of a Westinghouse 300 - horsepower, 220-volt, 3-phase, 60-cycle motor and a 225-kilowatt, 220-volt Crocker-Wheeler generator. A 10 - ton Whiting crane traverses the power house. The water system includes a Kennicott water softening plant and standpipe.

The location of the pig casting machine is shown in Fig. 19. It was installed by the American Casting Machine Co., Pittsburgh. The ladle house is 138 feet long, 65 feet wide and is provided with an 80-ton crane, built by the Cleveland Crane & Engineering Co., Wickliffe, O. The distance from the center line of the ladle house to the center of the pig loading tracks at the discharge end of the casting machine is 163 feet, 8 inches. The machine is electrically-driven by a compound wound, 40-horsepower, 220-volt, 160-ampere, Westinghouse motor, running 935 revolutions per minute. The motor is placed at the delivery end of the machine. It is belted to a jack shaft which is connected to the head sprocket through three spur gear reductions.

The plant was designed and constructed under the supervision of Julian Kennedy, engineer, Pittsburgh. The construction work was under the immediate direction of Victor Windette, resident engineer for Julian Kennedy. The reclamation work and dock construction was executed by the Great Lakes Dredge & Dock Co., Chicago, under the direction of E. J. Fucik, engineer. The buildings were fabricated and erected by the American Bridge Co. and the plate work on the stoves and furnaces was handled by Hibben & Co., South Chicago.

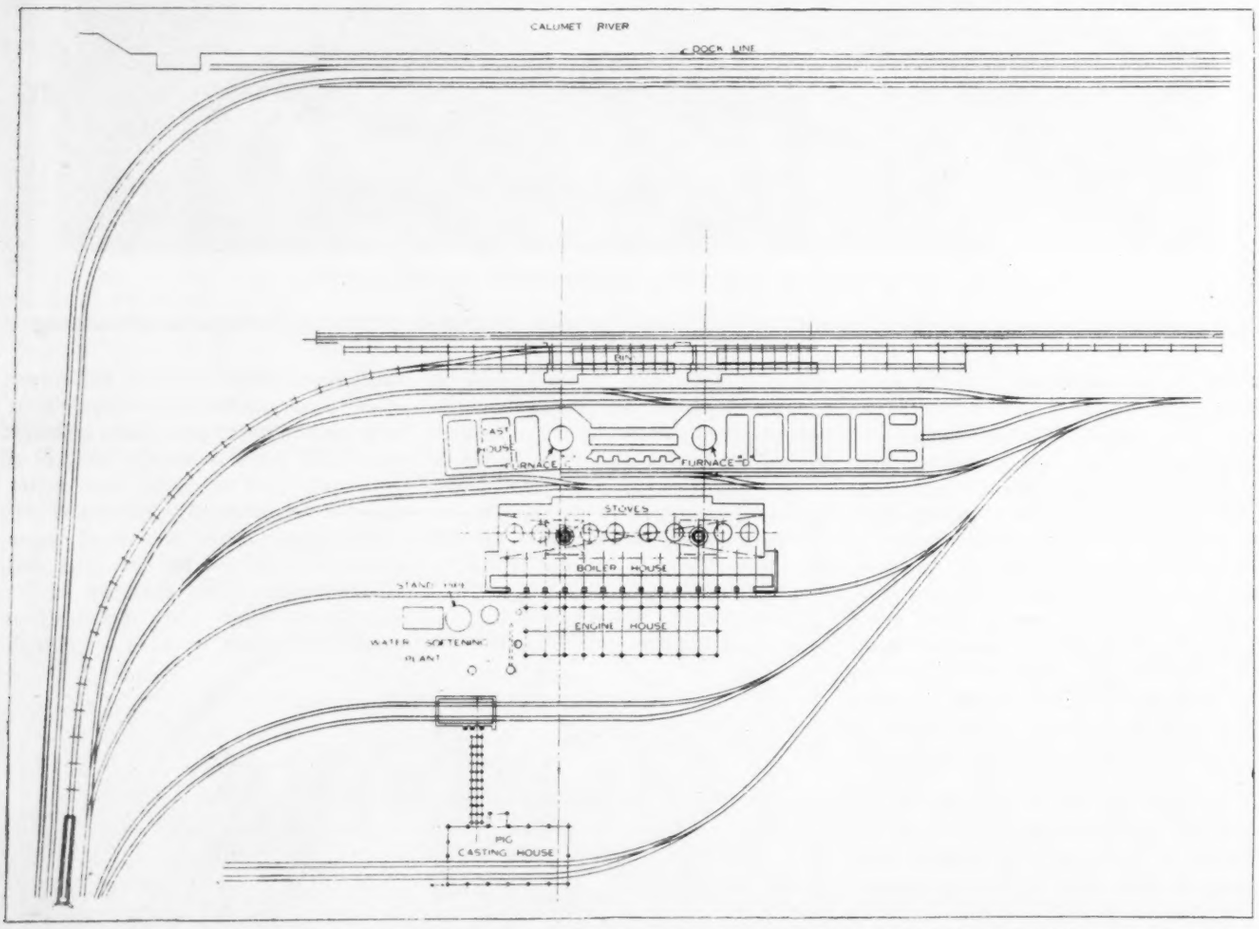


FIG. 19—GENERAL PLAN OF THE IROQUOIS FURNACE PLANT, SHOWING THE ORE DOCK FOUNDATIONS AND TRACKS

THE ABC OF IRON AND STEEL

The Manufacture of Bee-Hive Oven Coke

By J L Sherrick[1]

BEE-HIVE oven coke derives its name from the manner of its manufacture in round or bee-hive ovens, literally following the arrangement and shape of the bee-hive. It has only been within the last 30 or 40 years that coke has assumed an important part in manufacture and metallurgy in the United States. In 1850 there were only four plants for the manufacture of coke in this country. Reliable statistics are not available for the years preceding 1880, but in that year there were 182 plants with a total of 12,372 ovens and, in 1906, 532 plants with a total of 93,901 ovens. The bee-hive ovens now in the country aggregate over 100,000, producing coke each year valued at $100,000,000. From these figures it will be seen that the growth of the coke industry has been fairly rapid and this expansion has, in a large measure been brought about directly by the growth of the steel and iron business. The coke industry depending, as do all the other industries, upon the location and supply of the raw material, the location of the coal supply suitable for coking purposes must be considered as governing the production of coke in the different parts of the country. Geological records show seams of coal at different depths in the earth's crust under the formations belonging to the carboniferous age, and these are grouped in turn in three measures, the barren, lower productive and upper productive.

Theoretically, these deposits should extend across the continent from sea to sea and they probably do, more or less well-defined. Although the seams in different parts of the country may be identified by geological formations, they cannot be so identified by their chemical and physical qualities, as coal in the same seam very often has totally different

[1]Algoma Steel Co., Sault Ste. Marie, Ont., Can. This article was read and approved by J. R. Campbell, chief chemist of the H. C. Frick Coke Co.

The following articles of this series have previously been published in The Iron Trade Review: Iron Ore and Mining Operations, Jan. 5; Beneficiating Iron Ores, Feb. 2; Rules for Figuring Penalties and Premiums on Lake Superior Iron Ore, March 9; Transportation of Iron Ore on the Great Lakes, March 16 and April 13; Ore-Handling at Lower Lake Ports, Oct. 12, 1911.

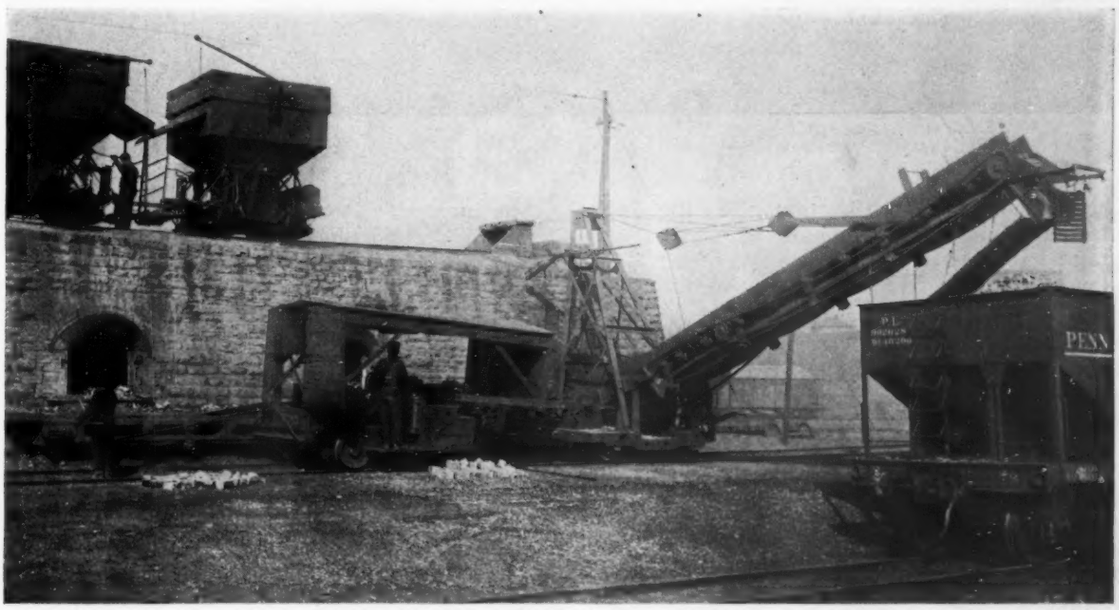


FIG. 1—COKE-DRAWING MACHINE WHICH ALSO LOADS THE PRODUCT INTO CARS. THIS VIEW SHOWS TWO ELECTRIC CHARGING LARRIES ON A TRACK ON THE COKE OVENS

characteristics within a comparatively narrow territorial range.

Furthermore, as each section has its own system of nomenclature, the difficulties of identification and relation are very much increased. These coals range in character from the graphite coal, unfit for fuel purposes, down through different forms of anthracite and bituminous to the brown coal and lignite. The coking coals, however, are found in only one class of coals, the bituminous. In Fig. 8 is shown a theoretical, columnar section of the various coal series in western Pennsylvania, Ohio and West Virginia.

The bituminous coal area of the United States is divided into seven parts: (1) The Triassic field, embracing the Richmond river basin in Virginia and the Deep and Dan river basins of North Carolina; (2) the Appalachian field, which includes the areas contained in western Pennsylvania, Ohio, Maryland, Virginia, West Virginia, eastern Tennessee, and Kentucky, Georgia and Alabama; (3) the northern field, which is confined exclusively to the central part of Michigan; (4) the eastern interior field, embracing coal areas contained in Indiana, Illinois and western Kentucky; (5) the western interior field, including coal areas west of the Mississippi, south of the forty-third parallel of north latitude and east of the Rocky mountains; (6) the Rocky mountain field, containing areas of the states and territories lying in the Rocky mountains; (7) the Pacific coast field, embracing the coal districts of Washington, Oregon and California. While the coking coals occur in the one class of coals only, the bituminous, and although all bituminous coals do not have the property of coking, nevertheless coking coals of varying degrees of quality are found in all of the seven sections of the bituminous coal area.

Most of the coal produced in the United States today, however, is from the one subdivision of the bituminous coal area, the Appalachian. This region, containing the areas of those states lying in the Appalachian mountain system, produces from 80 to 90 per cent of all the coke manufactured. There are about 100,000 bee-hive ovens in the country, and of these 45,000 are in the western Pennsylvania district, known as the Connellsville coke region. West Virginia and Alabama rank next to Pennsylvania, sometimes one holding second place and sometimes the other. The chief seam of coal coked in the Connellsville region is what is known locally as the Pittsburgh or No. 8 seam. This seam ranges in thickness from five to nine feet and is considered the best coking coal in the country. An approximate analysis of the Pittsburgh coking coal in the Connellsville region, follows:

	Per cent.
Volatile matter	30.10
Fixed carbon	62.65
Ash	7.25
Sulphur	1.126
Phosphorus	0.010

Of the other sections of the country, it is sufficient to say that they have suffered from

FIG. 2—DRAWING AND LOADING COKE BY HAND; ONE OF THE OPERATORS IS "WATERING OUT" AN OVEN

location, transportation facilities, and to a certain extent from the quality of coke produced in comparison with that from the Connellsville region. However, as the better and more accessible fields are worked out, the manufacturers must fall back upon these undeveloped sections for their supply of coke and it is only a question of time until these sections are developed.

The increase in the value of coal lands, in those sections in which coke manufacture has been carried on to any extent, has been phenomenal. Thirty or 40 years ago, in what is now the Connellsville coke region, coal of very good coking qualities could be bought for from $10 to $25 per acre, while within the last few years there are records of sales in the same region, in which as high as $3,000 per acre was paid for coal not above the average. However, $1,500 per acre may be said to be about the average price at present. Even in some parts of West Virginia, in undeveloped sections, a price of from $100 to $200 per acre is not unusual. An acre of the Pittsburgh seam yields from 8,000 to 10,000 tons of coal, which at the prevailing price of $1,500 per acre, makes it cost 15 cents per ton in the ground.

Before considering the requirements for a good coking coal, the properties which give a coal the quality of coking or not coking, as the case may be, should be discussed. In the investigation of this subject it is found that the property of coking is determined by the chemical composition of the coal itself and not, as often believed, by its physical structure. It might preferably be stated as the ratio of certain elements in the coal, for some elements, such as the impurities, which may vary through quite a considerable range without affecting the coking property, although materially affecting the quality and value of the coke produced.

The coking property, therefore, is determined by the ratio of hydrogen to oxygen in the composition of the coal. From experiments carried on along this line it is found that any coal with this H:O ratio over 50 per cent will coke. This subject is fully treated in Bulletin No. 382, United States geological survey, but it would be without the scope of this article to carry the discussion of this ratio any farther than to show that the coking property in a coal follows a fixed and determinable law. As will readily be seen, the H:O ratio must be fixed by an ultimate analysis of the coal proposed for coking purposes and not by the approximate analysis which popularly has been thought to be sufficient. We have seen almost identical analyses of two different coals in which one was coking and the other non-coking.

In place of the scientific disposition of whether a coal is coking or non-coking, the obvious thing to do is to make a practical test on ovens of the type in which it is proposed to coke the coal and then follow the action of the resultant product through all

FIG. 3—A BATTERY OF DOUBLE BLOCK COKE OVENS ARRANGED TO UTILIZE THE WASTE GASES. THE MAIN FLUE LEADING TO THE BOILER HOUSE EXTENDS UNDERGROUND BETWEEN THE MEN AND THE LARRY TRACK; CONNECTING FLUES LEAD FROM THE BANK OVENS TO THE MAIN FLUE

the requirements for satisfactory metallurgical operations.

Having fixed the requirements for a coking coal the qualities requisite for a good coking coal must next be considered. This leads to a consideration of the coke produced from the coal and it must be determined, therefore, what are the objectional qualities in a coke in connection with the purpose for which it is intended. The chief use for coke in manufacturing today is in connection with the iron and steel industries and to these we must look to determine what is objectional in a coke.

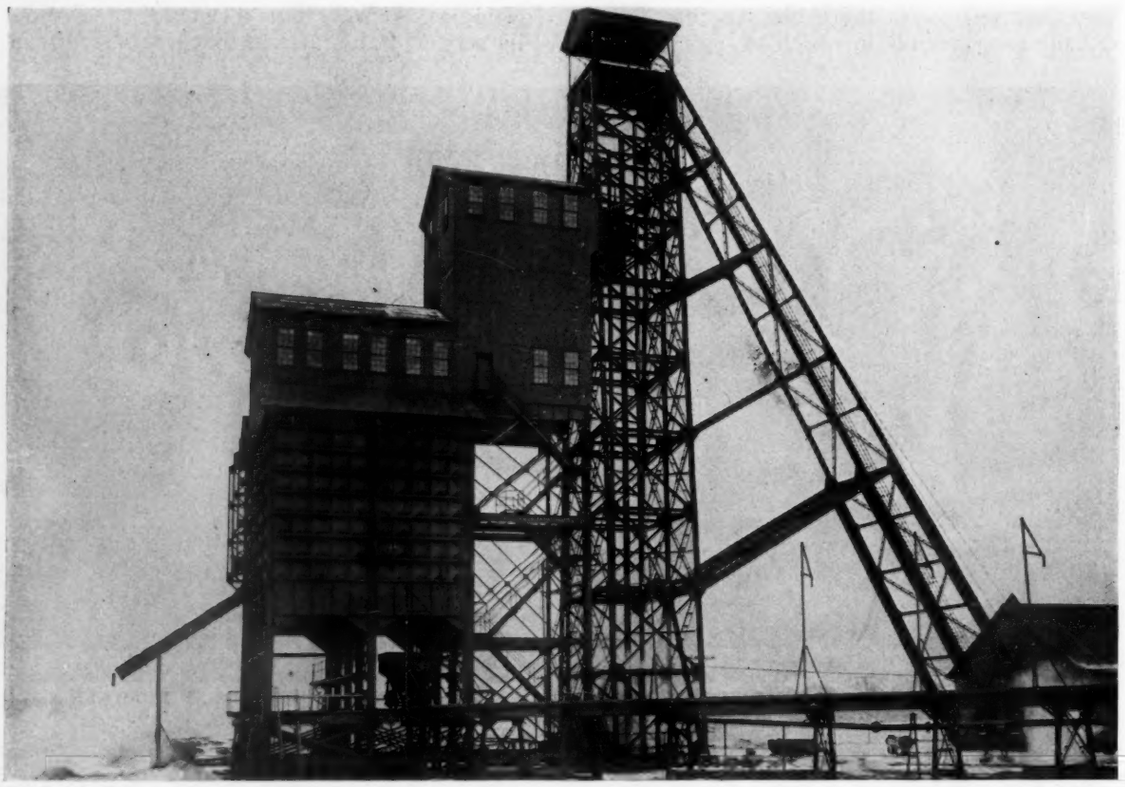


FIG. 4—HEAD FRAME AND STORAGE BINS OVER A SHAFT MINE. THIS IS A VIEW OF A MODERN STRUCTURE

The impurities in a coke which cause trouble for the furnace operator or foundryman are sulphur and phosphorus and to a lesser extent the ash, composed chiefly of alumina and silica, with small percentages of iron, lime and magnesia. Therefore, a limit must be set for these impurities in a coke and hence, also, in a coal from which that coke is produced.

In the coking process there are both chemical and physical changes and the change in the percentage of impurities from coal to coke can be deduced from the chemical changes known to take place. The theory of this change in the per cent of impurities brought about by coking depends, as does the whole operation, upon the volatile matter in the coal. This volatile matter is driven off and the coke which remains contains the whole of the impurities which existed in the greater weight of coal.

For example, if the volatile matter in a coal were 30 per cent, after coking only 70 per cent of the original weight of the material would remain to contain the same amount of impurities. The impurities in this case, then, would be multiplied by $\frac{100}{70}$ or 1.43, in the change from coal to coke; hence, the popular saying among coke men "it takes a ton-and-a-half of coal to make a ton of coke."

As far as ash and phosphorus are concerned this holds true, but still another factor enters into a consideration of the sulphur. The sulphur in the coal exists mainly in the form of iron pyrites, FeS_2, and, in coking, approximately half of the sulphur is driven off with the volatile matter. Therefore, the fac-

tor for ash and phosphorus would have to be further multiplied by 0.50, or 0.5 × 1.43, to arrive at the factor for sulphur. Briefly, if a ton-and-a-half of coal makes a ton of coke, the impurities of ash and phosphorus each will be increased 50 per cent and the sulphur decreased 25 per cent in converting coal to coke. In Table I are given several analyses of coal with the coke made therefrom.

From the analyses in Table I, it will be seen that, although the tests do not always agree with the theoretical, for the most part the theory holds good, when due allowance has been made for unavoidable errors, especially in the taking of uniform samples.

FIG. 5—METHOD OF HOISTING COAL FROM A SLOPE MINE BY THE CHAIN HAULAGE SYSTEM; ON ONE TRACK THE LOADED CARS ARE HOISTED, WHILE THE EMPTY CARS ARE RETURNED OVER THE OTHER TRACK

Lately there has been considerable investigation of methods for purifying coal and to make it possible to use some coals which would otherwise be unfit for the making of good coke. This is apparently the only hope of the coming generation of coke operators, unless the prevailing metallurgical operations can be adjusted to take care of the increase of impurities in the coke. Owing to the rapid depletion of the supply of coal low in the impurities of ash, sulphur and phosphorus, resort is had to various cleaning processes, either the dry or the wet, the former being usually accomplished by the revolving screen or Bradford breaker in which the coal, being softer than the impurities, is broken up and passes through the screen, while the impurities of bone coal, slate, etc., being harder, remain on it and are thus rejected as such; the latter is usually accomplished on jigs in which the coking coal of about 1.35 specific gravity is separated from the heavier impurities of slate, iron pyrites, etc., through the medium of water. The pulsation of the jig is regulated so as to float the good coal and at the same time to allow the impurities to sink and to be discharged as refuse. The dry process is not chemical in its operation, the cost being only a few cents per ton of coal treated, but unfortunately, it is not applicable to the majority of coal treated. The wet process at best is not altogether satisisfactory and the cost of installation is great, entailing a high fixed charge. The cost per ton of coal washed varies, of course, but perhaps 20 to 25 cents is near the figure. Washers seem to be a necessary evil, and every coke operator fights shy of them as

long as he can. So far a jig washer has not been perfected which will not carry a large percentage of coking coal in the refuse matter. This refuse may carry anywhere from 25 to 50 per cent of good coal, especially when it is desired to have a clean, washed product. In the wet process the coal is preferably crushed beforehand to a size that will free the impurities from the good coal. Some coals apparently defy all cleaning processes, as the sulphur seems to be in such a form that it cannot be separated from the good coal.

As most of the manufacturers of bee-hive oven coke mine their own coal, this operation should be considered first in attempting a description of the coking process. Bituminous coal mines have three methods of entrance, drift, slope and shaft. The drift entrance is possible where the coal has an outcrop on the side of a hill permitting of a direct entrance to the coal seam; the slope is used where the coal lying at a moderate depth can be reached by a gradual descent from the surface to the level of the seam; a perpendicular shaft is sunk when the coal lies at such a depth that a slope of too great a length or of too steep an inclination would be necessary for economical operation. The coal is either mined by machines or by pick, assisted by explosives. When mined it is loaded into wagons, of about 2½ tons capacity, running on a narrow gage track and brought to the mine entrance by mules, or a rope haulage, and in the case of more modern plants, by either electric or compressed air haulage systems.

The wagons are hoisted up the slope or shaft, by steam or electricity, onto the tipple and the coal is dumped into bins or directly into larries, as the case may be, after having first passed through any preliminary washing process it may require. The more modern tipples are large, well-designed steel structures with bin capacities for about 1,000 tons.

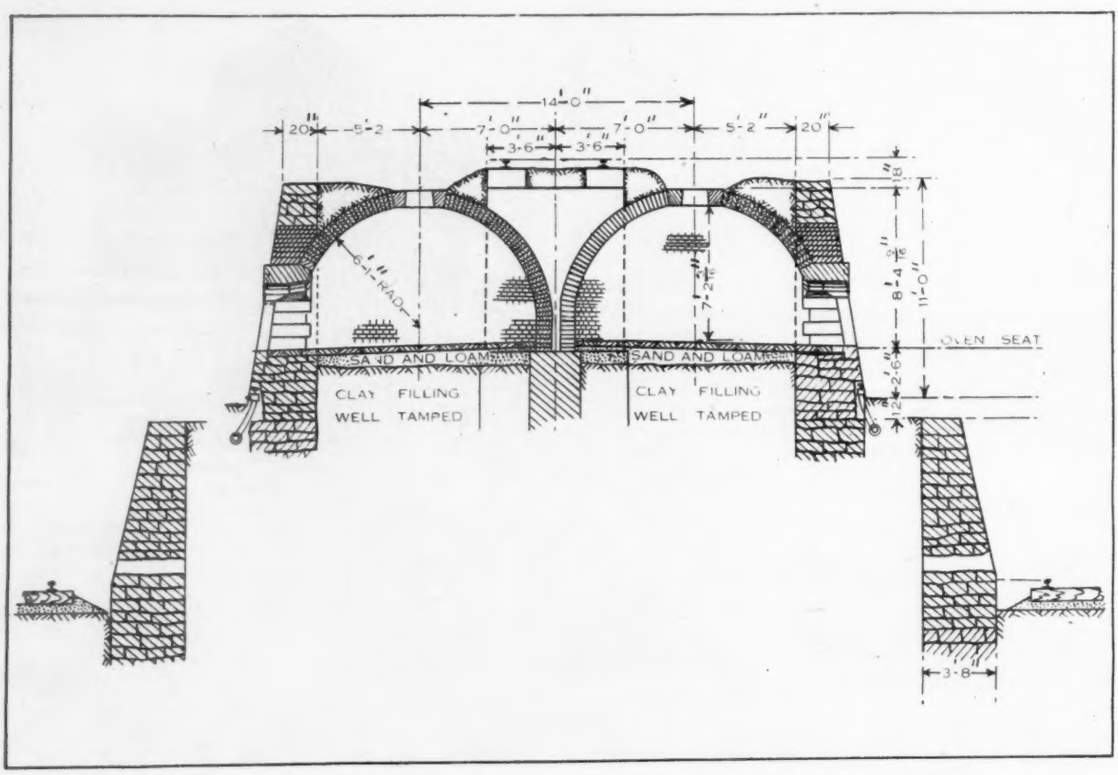


FIG. 6—CROSS-SECTION OF DOUBLE BLOCK, BEE-HIVE COKE OVENS, WHICH ARE BUILT BACK TO BACK AND THE INTERVENING SPACE BETWEEN THE OVENS IS FILLED WITH LOAM OR CLAY

The charging larries, steel, hopper-shaped cars of about nine tons capacity, receive the coal from the bins and along the top of the ovens on a track and deliver their charge of coal from the chute in their bottoms into the trunnel head of the oven. Each larry holds sufficient to charge one oven and the larries are drawn along the ovens by mules, small steam engines or by electric power. There are three different methods of arranging bee-hive ovens, although the con-

struction of the ovens themselves is the same. The bank system has a single row of ovens built against a bank which serves as a retainer for the clay or loam which is used to fill up the spaces unoccupied by the masonry; the single block system requires a wall in the back to retain this filling and the double block ovens are built back to back with the whole unused space between the opposite front walls filled with loam or clay.

Fig. 6 shows a cross-section of a double block system of ovens including the dimensions for a standard size oven and the details of construction. This diagram will answer for all three types of ovens if the slight changes in the manner of retaining the filling are remembered, as all other details are the same.

Before charging the coal, the oven door is closed about half way up with brick, or to a sufficient height that the coal charged

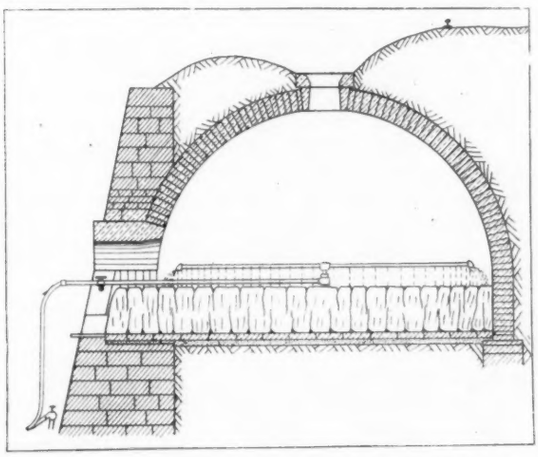


FIG. 7—CROSS-SECTION OF A COKE OVEN, SHOWING A WATERING MACHINE INVENTED BY D. B. STAUFT, GENERAL SUPERINTENDENT OF THE TAYLOR COAL & COKE CO.

may be leveled to a uniform depth throughout the oven. This so-called leveling process is accomplished by means of a large scraper in the hands of a laborer, or by leveling machines.

After leveling, the door is closed with bricks and mortar to within about one inch of the top, and the coking process proper begins. The ovens retain enough heat in their walls from the preceding charge to start the process, which then furnishes its own heat by the combustion of the volatile constituents of the coal. Also, in hand-drawn ovens, alternate ovens only are drawn and charged each day, so that the adjoining oven, which is already in full blast, furnishes heat to start the coking process in the green charge.

As previously noted, once started, the coking process is carried on by the combustion of the coal gases in the combustion chamber or crown of the oven. The coking process is not quite proportional to the time, but almost; it gradually grows slower as it continues. For instance, when a 48-hour charge is drawn at the end of 24 hours a little more than half is coke and, by the way, just as

FIG. 8—THEORETICAL COLUMNAR SECTION OF THE VARIOUS COAL SERIES IN WESTERN PENNSYLVANIA, OHIO AND WEST VIRGINIA

good coke as it ever will be, while the bottom is raw coal. However, when ovens are put in blast, it is necessary to bring them up to a proper temperature by burning preliminary charges of wood and coal in them before the coking process itself can proceed.

The coking operation is governed altogether by the amount of air allowed to enter

by regulating the aperture between the brickwork and the top of the door. The coking process consists of driving off the volatile constituents of the coal, leaving a strong, smokeless fuel composed of almost pure carbon contaminated only by the mineral impurities which existed in the coal.

In a six-day run the usual practice is to

FIG. 9—A LOADED TRIP OF PIT CARS BEING HAULED OUT OF A COAL MINE

make four charges of 48-hour coke and two charges of 72-hour coke, the latter being charged on Friday and Saturday of each week and drawn on the following Monday and Tuesday.

However, in special cases, 96-hour coke is made. There is practically no difference in the quality of the different hour cokes. A few more bushels of coal are charged for the longer periods to continue the coking process. A 48-hour charge is about 160 bushels; a 72-hour, 180 bushels, and a 96-hour charge, 200 bushels of coal. The yield of coke is dependent upon the volatile matter in the coal and in the Connellsville region is approximately 66 2-3 per cent of A-1 coke and 3 1-3 per cent of ashes, or breeze, as it is popularly known. The foregoing points are illustrated in Table II, which records actual charges of coal made into coke.

The coke is drawn from the ovens either by hand labor or by machines. In the case of hand-drawing, after the brickwork has been entirely removed from the door, the coke is drawn into the yard by means of long-handled scrapers in the hands of laborers and, by means of barrows, is loaded into cars ready for shipment. When the drawing is done by mechanical means, the machines draw the coke and load it directly into cars. However, it is necessary in this case to clean the small amount of coke from the ovens which it is not possible to reach by machinery. This last method is used mainly in those sections where there is a scarcity of labor.

One of the greatest objections to the manufacture of coke in bee-hive ovens is the waste due to the fact that no effort is made to recover the valuable products contained in the volatile matter, either burned or driven off into the air. In the last few years some effort has been made to use these gases, but not in the same way as is followed in the by-product process. The essential details of this plan are as follows: A system of flues leads from each oven to a large main flue which carries the gases, at the high heat of the coking process, into the combustion chamber of a set of boilers. In this way both the combustible part of the gases and the heat already contained in them are utilized.

Another type of oven, of which there are a few plants in the country, is the rectangular, or the modified Belgian. This is not a bee-hive oven in the sense the term is generally used, but operates on the same principle; in other words, it depends on the volatile matter for the heat necessary for the coking process and would logically be placed in the bee-hive class. The special advantage of this type of oven over the regular bee-hive is in the method of extracting the coke by *pushers* by which the coke is shoved out into the yard or directly into the railroad cars. The leveling and *watering-out* process are also accomplished mechanically, so that but little labor is required at a plant operating the modified Belgian ovens.

The cost of coke manufacture is a difficult question for consideration, since, as in most industrial processes, reliable figures for publication are not easily to be had. It may be somewhat roughly estimated at from

FIG. 10—A COMPRESSED AIR MOTOR USED FOR HAULING PIT CARS IN COAL MINES

$1 to $1.25 per ton. The complex character of figuring the cost may be indicated by some of the factors entering into the computation. Some of these may be briefly stated as follows: The original cost of coal and expense of mining; direct operating expenses of plant,

including labor, initial cost of installation of plant, repairs, taxes, insurance, depreciation in the value of machinery and buildings from use, interest on money invested and a fair profit.

As previously stated, the coke industry owes its growth, in a large measure, to the iron and steel industries, although coke is used in other metallurgical processes and wherever a strong, smokeless, solid fuel is desired. The blast furnaces for pig iron manufacture make use of a large per cent of the coke and, as the iron must have a certain minimum of impurities according to the process for which it is intended, the value of coke in the market is governed by the comparative freedom from those impurities so inimical to steel-making.

For instance, the acid Bessemer process requires that the phosphorus in the coke be not more than 0.017 to 0.020 per cent, while for the basic open-hearth process, the phosphorus can be considerably higher, since it can be removed in the steel-making process. In addition to blast furnace coke, there is considerable foundry coke being made, while in the early days of coke manufacture this was the big end of the coke business.

Table I.

Analyss of coal and the resultant coke.

	Coal, per cent.	Actual coke, per cent.	Theoret'l coke, per cent..
Volatile matter...	27.50	0.50	
Fixed carbon....	59.56	82.85	82.15
Ash	12.94	16.65	17.85
Sulphur	1.407	1.127	0.984
Phosphorus	0.043	0.062	0.060
Volatile matter..	28.50	0.50	
Fixed carbon....	61.75	87.36	86.35
Ash	9.75	12.14	13.65
Sulphur	1.201	0.718	0.840
Phosphorus	0.020	0.028	0.028
Volatile matter..	33.33	0.43	
Fixed carbon....	60.30	89.77	90.44
Ash	6.37	9.80	9.56
Sulphur	1.085	0.842	0.814
Phosphorus	0.007	0.010	0.010

The following analyses represent the chemical requirements for the various kinds of coke:

	Acid Bes., Per cent.	Basic Open-H'th, Per cent.	F'dry, Per cent.
Volatile matter...	0.58	0.48	0.52
Fixed carbon.....	88.80	88.27	88.95
Ash	10.62	11.25	10.53
Sulphur	0.872	0.850	0.750
Phosphorus	0.012	0.065	0.020

The chief difference between Bessemer coke and open-hearth coke is in the phosphorus content; the other chemical requirements are practically the same so far as the economical operation of the blast furnace is concerned. The main thing in the specification for foundry coke is to have a low sulphur content, as by remelting the iron in the cupola, the sulphur of the coke has a tendency to combine with the iron.

Aside from the chemical requirements there are always to be considered the physical qualities for the various metallurgical processes; thus, a furnace coke must be able *to carry the burden* properly and should be of the proper cellular structure for the admission of the blast, while foundry coke must be smaller in size and of close cellular structure. Hence, it was the former practice to make furnace coke on 48-hour charges and foundry coke on 72-hour charges, since it was believed that the former gave a large cell coke and the latter, a close cell structure. There is no distinction between 48-hour and 72-hour coke for furnace purposes and it would take a real expert to detect the difference so far as the cell structure is concerned. The best way is to measure the coke, as the 72-hour coke is always a trifle longer than the 48-hour coke, due to the heavier charge.

Table II.

Coal Charges and Coke Yield.

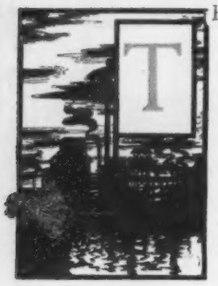
	12-foot oven, wet.	96-hour, dry.
Pounds coal charged...	18,135	17,768
Pounds coke drawn....	11,993	11,708
Per cent yield.....	66.13	65.88
Per cent moisture.....	2.37	.....
Ash, pounds.....	677	661
Per cent ash.....	3.73	3.73
Volatile mat. in pounds	5,465	5,399
Per cent volatile matter	30.14	30.39
Moisture in coal.....	2.02	.....
	12-foot oven, wet.	72-hour, dry.
Pounds coal charged...	15,510	15,192
Pounds coke drawn....	10,376	10,133
Per cent yield.....	66.90	66.72
Per cent moisture.....	2.35	.....
Ash, pounds.....	540	527
Per cent ash.....	3.51	3.45
Volatile mat. in pounds	4,554	4,494
Per cent volatile matter	29.33	29.57
Moisture in coal.....	2.07	.....
	12-foot oven, wet.	48-hour, dry.
Pounds coal charged...	11,553	11,382
Pounds coke drawn....	7,863	7,662
Per cent yield.....	68.04	67.29
Per cent moisture.....	2.55	.....
Ash pounds.....	394	383
Per cent ash.....	3.41	3.37
Volatile mat. in pounds	3,273	3,314
Per cent volatile matter	28.35	29.14
Moisture in coal.....	1.48	.....

The bee-hive oven coke process is, at best, a wasteful one and it is probably only a question of time until it is replaced almost entirely by the by-product process.

The Scientific Management of a Foundry

The Use of the Slide Rule for Setting Piecework Prices for Molding in a Large Casting Shop in the West

By Charles J Simeon



THE term, *scientific management*, applied to manufacturing, embraces such a wide range of methods, systems and appliances that a short, comprehensive definition is almost impossible. Perhaps the phrase, *get posted beforehand*, covers as large a portion of the field as could be described by any sentence of equal length. That is to say, a large part of scientific management has to do with insuring that the factory has satisfactory answers, before it does a stroke of work, to the three following questions:

Exactly what has to be done?
What is the best way to do it?
How long should it take?

A pre-knowledge of the answer to each of the above questions is of paramount importance to successful manufacturing, but only the last will be considered in this article.

The labor cost is that portion of the total cost which is generally the largest and nearly always the most elusive and difficult to regulate. Accurate, prior knowledge of the time in which work should be done has a value that cannot be overestimated in reducing the labor cost under day work, and is an essential under a piecework, bonus, premium or kindred system. Thanks to Messrs. Taylor, Barth and others, the problem of ascertaining the proper times for machine work has been standardized and the solution reduced to mathematical form so that it is a comparatively simple matter to calculate the exact time in which a given piece of machine work should be done.

Methods of Setting Piecework Prices

But, so far as the writer knows, no similar attempt at a mathematical analysis of the foundry problem has been made. There are, of course, many methods employed for setting piecework prices or determining premium or bonus times for foundry work, the following being the ones generally followed:

(a) The personal judgment of the superintendent, foreman or other official.

(b) Comparison with records of previous performance.

(c) A tonnage of weight basis.

(d) Time study.

Each of these methods has its disadvantages, as follows:

(a) The personal judgment method, unless much time and care are taken, is little better than intelligent guesswork.

(b) Comparison with records requires that the same or a closely similar piece be made a number of times previously, and at best is a plunge in the dark as the conditions obtaining when the record was made, which have an important bearing, are seldom recorded, and quickly forgotten.

(c) A tonnage basis is approximately accurate when applied to small and similar work, but may be grossly misleading in other cases.

(d) The time study method is good, but too cumbersome and long for frequent and continuous use.

Premium Plan

All of the above methods may give good results under certain conditions, particularly when the work is repetitive and similar, but will seldom prove satisfactory where a line of castings, diverging considerably in weight, shape and intricacy, are made. Such conditions prevail in the foundry operated by the company by which the writer is employed. This concern builds several types of heavy machinery in a number of sizes and operates large steel and iron foundries in connection with its other shops. The castings required run in all weights from a few ounces up to 10 tons each and through a corresponding range of intricacy. A large proportion of the tonnage, moreover, consists of castings that are not made more than once or twice in a year. The premium plan of payment is in use throughout the factory and it is the writer's duty to supervise and approve all rates set, including those in the foundry.

Until about 18 months ago all premium rates in the foundry were set by one of the previously outlined methods. At that time, the predecessor of the writer conceived the idea of analyzing all the elementary operations performed in molding, expressing them in mathematical form. He carried out a series of time studies and produced a molding formula that gave good results, and the writer continued the work and modified the formula to one that could be used with a logarithemic slide rule.

Slide Rule for Setting Rates

As will appear later, the slide rule method of setting rates is, in reality, a modification of the time study method. For the slide rule is virtually a table, compiled from a large number of time studies, which gives the unit times required for performing the various elementary operations, and is a convenient method of combining these elements with the dimensions and intricacy of the casting to give the total time required by the whole. To understand how the formula was derived, let us consider an example.

A typical floor molding job may be split up into the following elementary operations:

1—Clear the floor, set the bottom board, the drag flask and the pattern.

2—Shovel facing sand and ram around the pattern.

3—Shovel bank sand and ram up the drag.

4—Clamp the bottom board and drag.

5—Obtain crane and roll-over the drag.

6—Remove the clamps and bottom board, sweep-off, place cope and sprinkle parting sand.

7—Set runners for heads and gate, shovel facing sand and ram around the pattern.

8—Set gaggers, shovel bank sand and ram up cope.

9—Obtain crane, lift off cope and remove pattern.

10—Finish mold, cut brackets, nail and coat with silica wash.

11—Finish heads and gates.

12—Set cores, chaplets and chills.

13—Obtain crane, pick up cope and test for correct core-setting.

14—Close-up and clamp ready for pouring.

The formula and slide rule, as ultimately developed, are based upon the theory, verified by actual time study and observation, that the times required for performing each of the elementary operations enumerated, are, within a de-

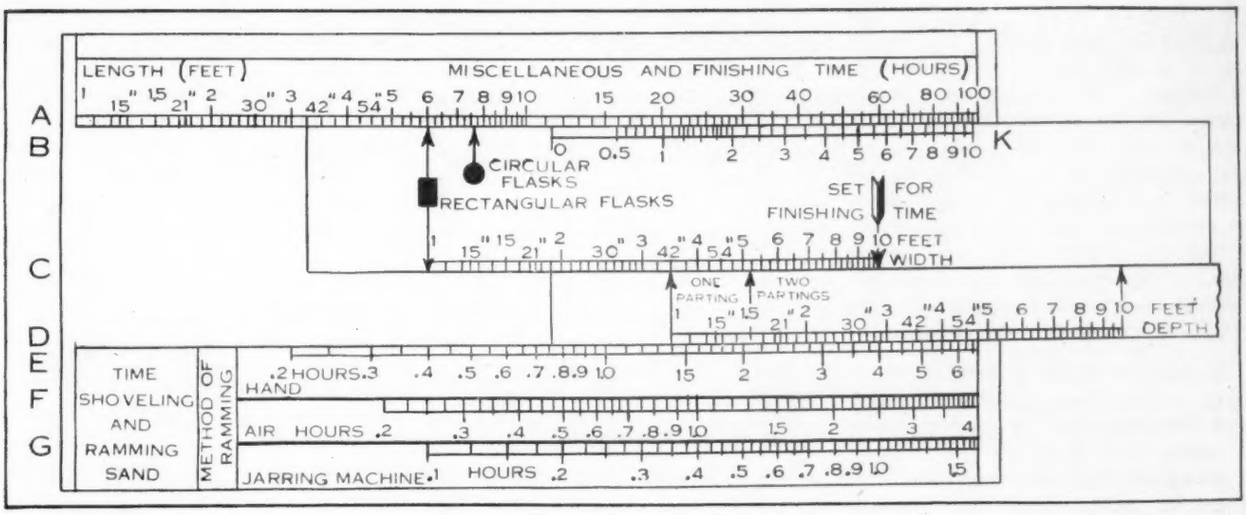


FIG. 1—SLIDE RULE IN FIRST POSITION

gree of accuracy, close enough for practical purposes, functions of one or more of the dimensions of the flask, certain of these times being, in addition, functions of the intricacy of the pattern and the method of ramming employed. The formula derived was in this form:

$$T = \frac{\sqrt{A}}{a} + \frac{A}{b} + \frac{AK}{c} + \frac{Vr}{d}$$

Where T = The proper molding time.
A = Area of the flask in feet.
V = Volume of the flask in feet.
K = A variable known as the *Intricacy Factor* of the pattern.
r = A constant, known as the *Ramming Factor*, depending on the method of ramming, whether by hand, by air rammer or by jarring machine; a, b, c and d are constants.

It will be observed that the problem is now comparatively simple; *A* and *V* are known or can be measured, and *K* is the only unknown factor which must be estimated, or otherwise determined. *K*, as already stated, is the *Intricacy* or *Finishing Factor* of the pattern, that is to say, its comparative intricacy, as to cores and loose pieces, hollows and projections, etc., which will make the mold harder or easier to finish and close. It is practically dependent on shape alone, not size. Thus, if *K* be known for a 3-foot diameter sheave, it is known for all sheaves of the same general form regardless of size.

The Intricacy Factor

It readily will be seen that by a series of careful time studies a table can be compiled of the values of *K* for a few patterns, typical of those in common use in any given foundry, and the value of *K* for any particular pattern can be determined easily and quickly by comparison with these landmarks. This has been done in the foundry in which the writer is employed, and a few days practice enables an assistant to set rates, with a high degree of accuracy, on a very large percentage of the varying patterns in use.

It will doubtless be argued that if *K* has to be estimated, this method of rate-setting is no better than the personal judgment method. A little reflection, will, however, show that such is hardly the case. An inspection of the schedule of elementary operations in the imaginary example taken will show that out of the 14 operations, only two, Nos. 10 and 12, have an intimate connection with *K* and four others, Nos. 2, 7, 9 and 13, bear only a slight relationship to *K*. Similarly, only one term out of four in the formula contains *K*. Any error in estimating *K* will, therefore, only affect the final result partially, the remainder of the time being known absolutely. On the other hand, an estimate based on the personal judgment method must, unconciously, cover all the variables mentioned, with the consequent possibility of error in the estimation of each.

It must not be imagined that the inference is intended that the proportion of elementary operations and terms affected by *K* is a full measure of the

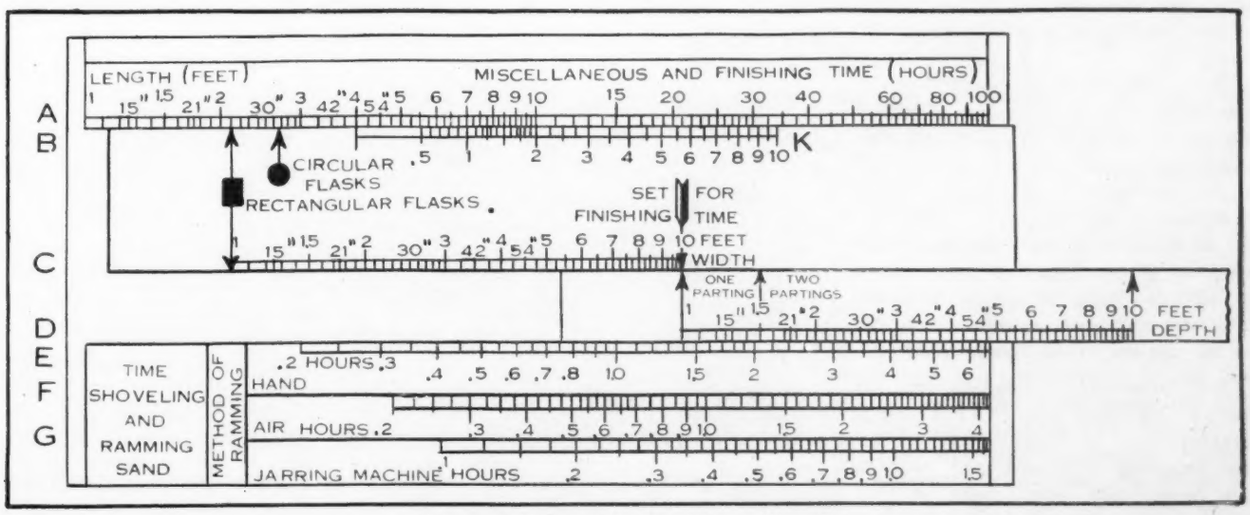


FIG. 2—SLIDE RULE IN FINAL POSITION

effect that the intricacy of the pattern has upon the whole molding time, though this is actually true in a large number of instances. But the intricacy of the pattern has, in fact, less bearing on the total molding time than might be at first supposed. It is, to a considerable extent, overshadowed by the heavy work of shoveling and ramming so many cubic feet of sand, and the miscellaneous items of clearing floor, clamping, rolling-over, etc., none of which has any relation to the shape of the pattern.

In this connection, it may be of interest to state that when the slide rule was first introduced, the foundry superintendent was politely skeptical and the foremen of both the iron and steel foundries openly ironical over the idea of setting rates by rule on such intangible work as molding. However, after a few demonstrations, all three asked to be given slide rules for their own personal use.

A few words on the average values of *K* may be in order. As will be seen from the illustrations, provision is made for a possible variation in the comparative intricacy of patterns from 0.5 to 10 or a range of 20 to 1. In practice, however, although our foundry handles many intricate patterns, 6.0 is the highest value we have yet had to use, this value being correct for double engine cylinders with two cylinders, steam chest and steam and exhaust passages cast in one piece. The average value of *K* for all patterns handled is around 1, and its value probably does not exceed 2 for 75 per cent of all patterns commonly used.

The formula, as given, cannot be used in connection with a logarithemic slide rule, but a simple modification renders it suitable. A rule based on such a modification, is shown in Figs. 1 and 2.

The Formula Explained

There are seven scales marked respectively *A to G*. Of these, *B* and *C* are on one slide, *D* on a second slide and the others on a fixed base; *A*, *C* and *D* are graduated in feet representing respectively the lineal dimensions of the flask. The graduations on *A* also represent hours. Scale *B* provides for *K*, while *E*, *F* and *G* are all graduated in hours, each scale standing for a different method of ramming the mold.

The answer is obtained in two parts. One from scale *E*, *F* or *G*, as the case may be, which gives the time for shoveling the sand and ramming the mold. The other from scale *A*, which gives the remainder of the time. These two must be added together to obtain the total time.

To use the rule, set the arrow of scale *B* against the length of flask on *A*, and the arrow of *D* against the width of flask on *C*. Then hold the small slide stationary while the large slide is brought back until the arrows of *C* and *D* are opposite each other. Then read the time required for shoveling and ramming sand on the correct scale *E*, *F or G*, beneath the depth of the flask on *D*, and the finishing time on scale *A*, over the correct value of *K* on scale *B*.

If the flask is circular its diameter will take the place of length on the *A* scale and width on the *C* scale and the arrow on *B*, marked *Circular flasks* should be used.

If the flask has two partings, the large slide must be set in the final setting with the arrow on *C* opposite the arrow on *D* which is marked *Two Partings*.

Figuring the Intricacy Factor

The two illustrations give the settings necessary for the solution of a problem in which the flask is 6 feet long, 3¼ feet wide and 3 feet deep, with one parting. Fig. 1 shows the first setting of both slides and Fig. 2 the second setting after the larger slide has been brought back to its final position.

If the pattern had an intricacy factory of K = 1.25 and the mold were air-rammed, we read the *Miscellaneous and finishing* time on scale *A*, Fig. 2, over K = 1.25, to be 7.75 hours and the *Shoveling and ramming* time on scale *F*, below 3 feet deep on scale *D*, to be 2.6 hours, making a total of 10.35 hours for the whole job.

If the mold had been hand-rammed we would have used scale *E*, instead of *F* and the ramming time would have been 4.15 hours, making a total of 11.90 hours for the job.

The particular rule shown is graduated to read in *Premium Time Limits* direct, that is, a certain percentage has been added to the proper time, but it could be arranged instead to give the actual time that the work should take which would be required for setting bonus or piecework rates.

In conclusion, it may be said, that no claim is made for the discovery of an exact mathematical solution of all foundry time problems. In the first place, the formula on which the rule is based is empirical and therefore, only approximately correct and capable of improvement. In the second place, it does not profess to cover the entire field of foundry work; but it is claimed that the slide rule, when intelligently used within the range for which it is built, does give results that are more correct and uniform, and that with an expenditure of less time, than is possible under the usual methods.

In the foundry referred to this slide rule is applied to 80 to 90 per cent of the floor work and another formula, on the same principle, is applied to all machine-molding.

Tests of Suction Gas Producers

A bulletin containing data on tests of a suction gas producer has just been issued by the engineering experiment station of the University of Illinois. It was prepared by C. M. Garland and A. P. Kratz, the apparatus under investigation being a No. 3 producer manufactured by the Otto Gas Engine Works, Philadelphia. This type of producer is designed for intermittent operation, the length of the runs not to exceed 12 hours. Some of the conclusions arrived at as a result of the tests are as follows:

The efficiency of the producer is, within wide limits, practically independent of the rate of gasification. The efficiency is, furthermore, only slightly affected by the relative percentages of H_2 and CO appearing in the gas. With low temperature in the fuel bed, due to the use of a large quantity of steam, there is a high percentage of H_2 and CO_2. With high temperature in the fuel bed, the H_2 and CO_2 drop off while the CO increases. It follows, therefore, that the amount of steam to be used under any given conditions depends entirely on the nature of the fuel. Clinkering coals require large quantities of steam in order to keep the temperature below that of the formation of clinker, while non-clinkering coals require much less steam. An increase in the size of fuel tends to cause the efficiency, heating value of the gas, and the percentage of CO to drop off. The volume of gas generated per pound of coal averaged about 76 cubic feet.

Electric Steel Furnaces

There are about 70 to 80 electric arc furnaces in operation or being built for refining steel, mostly in France and Germany, says *The Engineer*, London. In Norway, Sweden and California there are several for the reduction of iron ore. Of induction furnaces for steel refining there are said to be between 30 and 40 in operation or under construction, mostly in Germany. About 17 tons of artificial graphite are produced daily in electric furnaces; also about 6 tons of bi-sulphide of carbon, and all of the aluminum.

A Discussion of Modern Engine Lathe Methods

Some Interesting Examples of Lathe Work With Detailed Description of Attachments for Special Machine Shop Operations

By Henry M Wood

A LARGE factory specializing in the manufacture of engine lathes only, and turning out machines which are meeting with success, is the logical place to look for examples illustrating the best uses of the engine lathe. For this reason this article is based upon the practice of a large machine tool manufacturing plant[1] in Cincinnati, and a few examples of the methods adopted by this company give a good insight into the possibilities of the engine lathe in a manufacturing plant.

Much of the present speed in turning out duplicate lathe work is due to the recently developed multiple stops. This mechanism is a combination of adjustable stops for length feed and cross feed, whereby all measurements after the first setting of the tool are obtained mechanically instead of by the former cut-and-try method of determining the finished size of each piece being turned. The lathe, illustrated in Fig. 1, is fitted with these new stops.

The length feed stops can be set to trip the feed automatically wherever desired. The bar, *A*, supported in brackets along the front of the bed carries five sliding stop dogs on its dove-tailed upper surface. This bar has a longitudinal movement against the pressure of a spring, and this movement is transmitted through a pivoted lever to disengage a jaw-clutch on the lead screw. A flat lever swinging in a vertical plane is attached to the lower left hand corner of the apron, so that it can be dropped into line with the dogs, or raised clear of any of them. When this lever is in its lower position, it can engage any one of the dogs and thus automatically trip the feed at all points determined by the setting of the dogs. One desirable feature of these dogs is that they will overlap each other, if necessary to set them close together, so that any distance between shoulders, no matter how short, can be measured off on the stops. Another point is that a dead stop is provided for the bar after the tripping of the clutch, so that exact distances between shoulders can be duplicated.

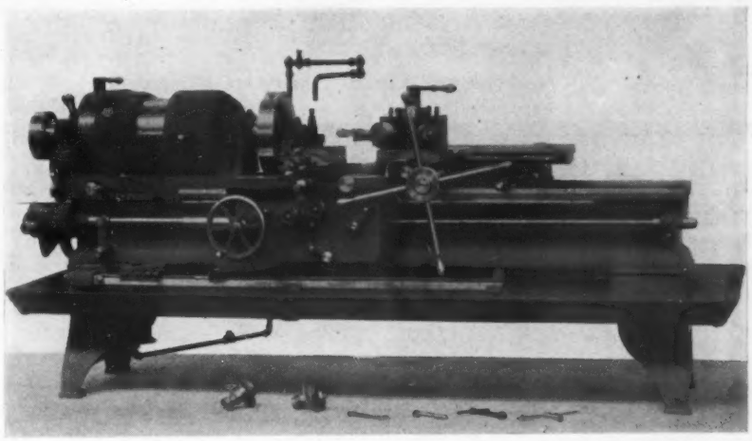


FIG. 2—FIRST OPERATION ON AUTOMOBILE HUB

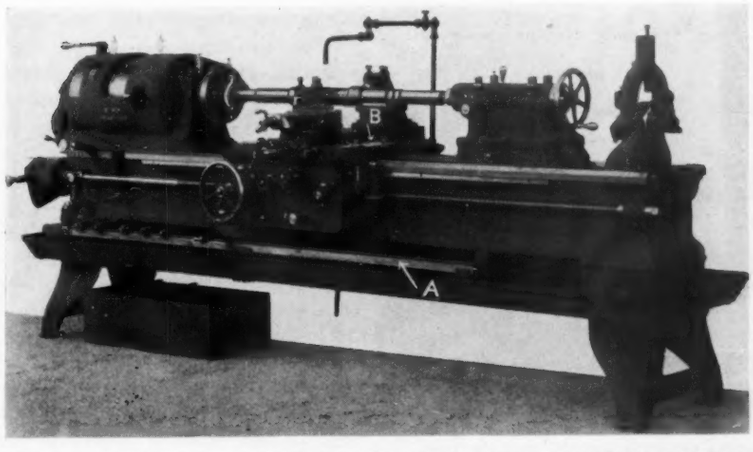


FIG. 1—SETTING UP ENGINE LATHE TO TURN ARMATURE SHAFTS

To rapidly and accurately duplicate different diameters, stops are provided for positively locating the cross slide in any desired positions. In Fig. 1, and more clearly in Fig. 9, is shown a shaft, *B*, parallel to the bridge of the carriage and journaled in the front and rear carriage wings. Five T-slots are milled lengthwise of this shaft and each slot carries an adjustable stop, which can be clamped in any desired position. If the lathe has front and back tools, there are two stops in each slot, one for the front tool and one for the back. A lug on the cross slide is so placed that as the tool is fed up to the cut by

[1] Lodge & Shipley Machine Tool Co., Cincinnati.

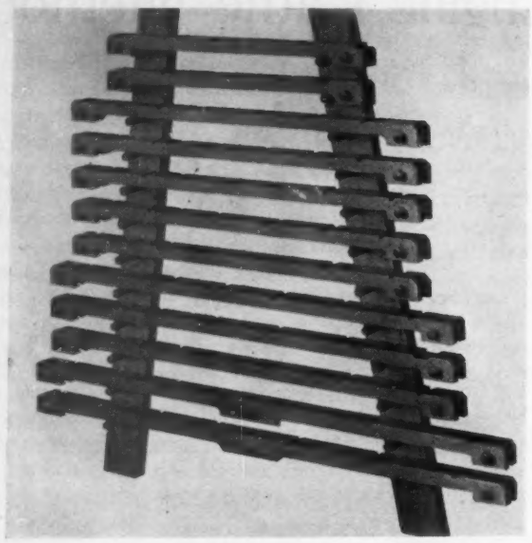


FIG. 3—SPACING BARS

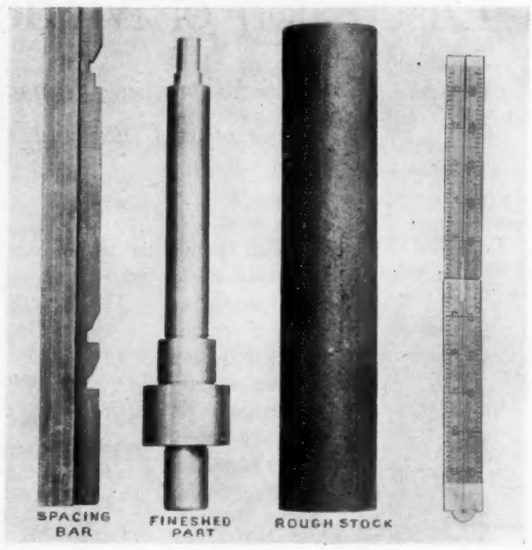


FIG. 4—TRAVERSE FRICTION STEM OPERATIONS

hand, the lug will engage one of the stops when the proper point is reached. This limits the cross travel of the tool and determines the finished diameter of the work.

Under former methods it was necessary when turning parts requiring squared shoulders, either to remove the turning tool and insert a squaring tool for finishing the shoulders of each piece separately, or else to make a second operation on the entire lot for the squaring and facing of shoulders.

Connected compound and plain rests, with which the lathe shown in Fig. 1 is equipped, now permit the turning and facing and squaring of shoulders without the loss of time formerly occasioned by making a separate operation. A lower extension slide is tongued and grooved into the regular compound rest slide and carefully gibbed to the carriage dovetail, so that the front and back slides both are operated as one by the cross feed screw.

A regular lathe tool in the compound rest at the front does the turning, and an inverted tool in the rear plain rest squares the shoulders. The turning tool is first fed in to the proper diameter, as determined by the diameter stop. The power length feed is engaged and remains in until contact with the first dog of the length feed stop mechanism trips the feed automatically, thus determining the first shoulder position on the work. Holding the carriage there, the operator feeds the cross slide toward him, which withdraws the front tool from the cut and brings up the rear tool to square the shoulder, and also to neck a few thousandths of an inch below the turned diameter, to give clearance for the grinding wheel in case the piece is to be subsequently ground. The diameter stop bar is then turned to the next position. The front tool is fed to the point determined by the next diameter stop and the length feed re-engaged by simply raising the lever on the apron clear of the first dog.

When successive lots of the same part are turned it is of further advantage to use a fixed template or spacing bar for the length stop mechanism, instead of the adjustable stops. This additional refinement saves even the slight time necessary for setting up the dogs and insures that the distances between shoulders on all pieces of subsequent lots turned to the same spacing bar will be exactly the same. A spacing bar, one of which is shown in use in Fig. 9, *C*, has fixed notches across its top at the proper distances apart to correctly locate the shoulder positions on the piece to be turned. The lever on the apron successively drops into each one of these notches just as, when using the adjustable stops, the same lever successively engages each one of the stop dogs. Thus the spacing bar constitutes an accurate jig for determining shoulder positions on lathe work.

Fig. 3 shows a group of these spacing bars used in the Lodge & Shipley plant for turning lathe spindles. The two small bars at the top of the rack are notched to conform to shoulder position on 14-inch patent head and 14-inch cone head spindles. The spacing bars next beneath are for 16-inch patent head and cone head spindles and so on down. Thus, when a lot of 16-inch spindles is ready to be turned, it is only necessary for locating the shoulder positions exactly, to slip on the proper spacing bar and clamp it in position. Each spac-

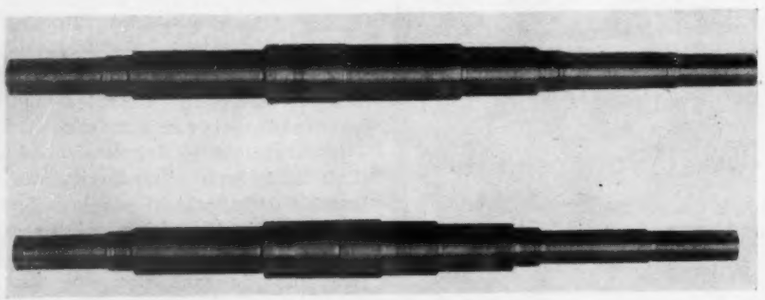


FIG. 5—ARMATURE SHAFTS TURNED WITH AID OF MULTIPLE STOPS

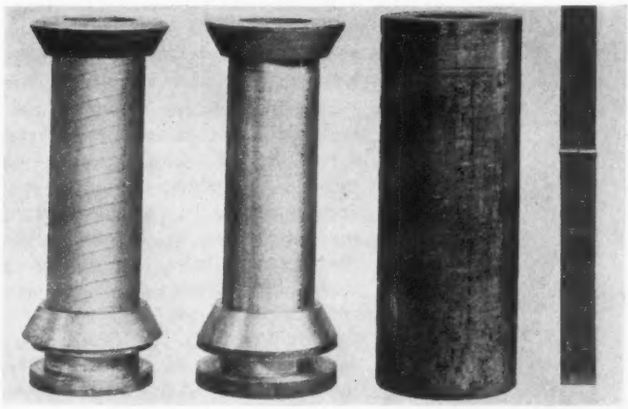


FIG. 6—OPERATIONS ON DOUBLE BEVEL PINIONS

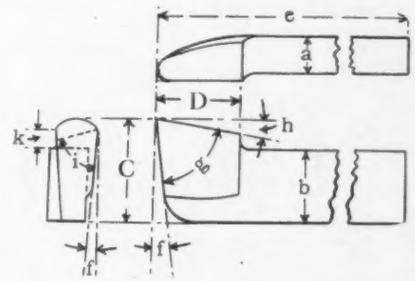


FIG. 7—STANDARD ROUGHING TOOL

ing bar is stamped for convenient identification, either with the symbol and piece number, or with the name of the part for which it is to be used, or with both. These spacing bars can be stored in the tool room and delivered to the workmen on check, as required for the operation at hand.

To get the best results from engine lathes, or for that matter other machine tools, the cutting tools should be standardized. Fig. 7 shows standard roughing tools used by the Lodge & Shipley Machine Tool Co., and recommended for general engine lathe work, especially with connected compound and plain rests.

It will be seen at a glance that the difference between this tool and most others consists in the shape of the cutting edge. Instead of having the cutting edge a curve on a large radius, the Lodge & Shipley standard roughing tool has a straight cutting edge at the left with a round nose of comparatively small radius of curvature. The tool is so clamped in the tool holder that this straight line cutting edge comes at right angles to the axis of rotation of the job being turned.

If it were merely a question of rapidly removing stock, a curved cutting edge would be preferable, because it gradually reduces the thickness of the shaving as it approaches the bottom of the cut, and thus there is less tendency to tear the finished surface of the work when pulling off the chip. On the other hand, a tool with a broad nose, and cutting edge a portion of a curve, is more liable to cause chatter. The main reason for using a tool with a straight cutting edge is to leave the shoulders nearly square. If a roughing tool with curved cutting edge were used, there would be so much of a fillet at each shoulder position that it would be difficult, if not impossible, to square up the shoulders nicely at one cut.

This tool removes the metal cleanly and quickly, with comparatively small power consumption. It is suitable for a large range of work, and if well upset when originally forged, allows considerable grinding before re-dressing is necessary.

Clearance of Tool

The clearance, angle *f*, Fig. 7, is eight degrees for tools up to 1 inch by 2 inches, and six degrees for larger tools. Greater clearance would allow the tool to be fed into the work easier when setting for the proper depth of cut, but this is not an important consideration; and every increase in the clearance angle takes off an equal amount from the lip angle, thus making the cutting edge liable to crumble.

The side slope, angle *k*, is 10 to 14 degrees for hard steel to medium steel and cast iron. For softer steel the side slope may be increased advantageously to 22 degrees or even more if the steel is very soft. The most important consideration in choosing the lip angle, which is determined by the clearance and slope angles, is to make it sufficiently blunt that there may be no danger of the tool crumbling at the cutting edge. Experiments have shown that a lip angle of 54 degrees removes metal with minimum pressure on the tool. Such an angle, however, is too sharp for practical purposes, as it would not be sufficiently durable.

The back slope, angle *h*, is 6 to 8 degrees. This is made less than the side slope because a steep back slope would grind into the body of the tool and weaken it, and would run the chip back against the tool post. On the other hand, a comparatively steep side slope makes the tool easier to feed, reduces the tendency to force

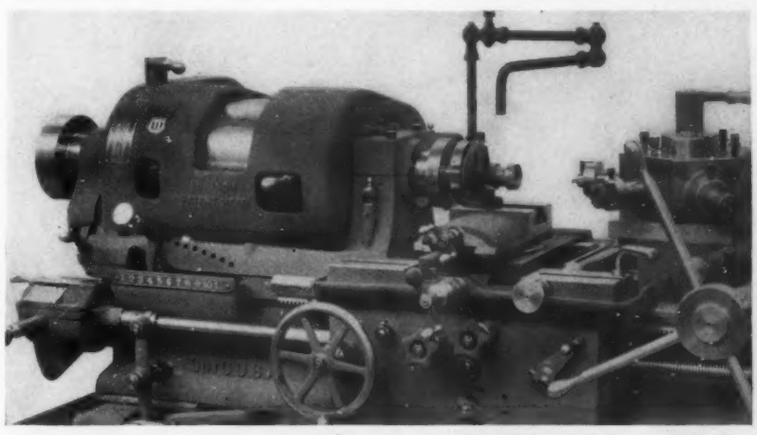


FIG. 8—SECOND OPERATION ON AUTOMOBILE HUB

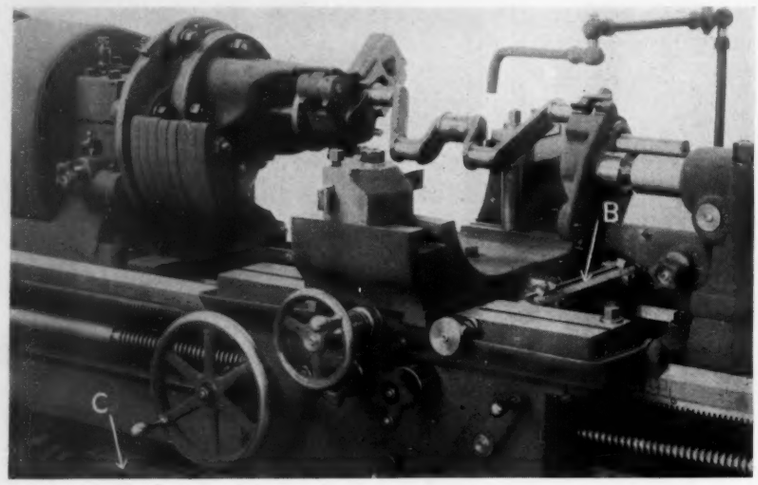


FIG. 9—TURNING AND FILLETING CRANK SHAFT PINS

the tool to one side, and runs the chips off sideways.

A stream of soda water or other cutting compound discharged at the point of the tool allows, in general, the use of much faster cutting speeds. It reduces heating of the work and the tool, and acts as a lubricant. Cutting compound should almost always be used when cutting steel, and frequently is helpful on cast iron.

The regular equipment for using cutting lubricant is that illustrated on the lathe shown in Fig. 1. The bed is mounted on short legs so that the whole sets in a large steel pan which catches the chips and the lubricant. A strainer in one end of the pan allows the lubricant to drain into a box placed beneath the pan. The pipe which discharges the lubricant at the cutting tool is connected through a circulating pump with this box. Thus the pump maintains a continuous flow of lubricant from the box onto the work and back to the box.

Fig. 1 illustrates standard lubricating equipment in use when turning steel. Fig. 2 shows similar equipment used for cast iron. In the operation shown in Fig. 10, where gang tools are used, a horizontal pipe discharges the lubricant on all four gang tools. Fig. 20 shows two vertical discharge pipes, one for each of the chasing tools. For the operation shown in Fig. 23, a brass tube let into the body of the drill carries the lubricant to the lip of the drill.

The two armature shafts shown in Fig. 5 are typical illustrations of the character of work to which the patent head lathe with multiple stops and connected compound and plain rests,

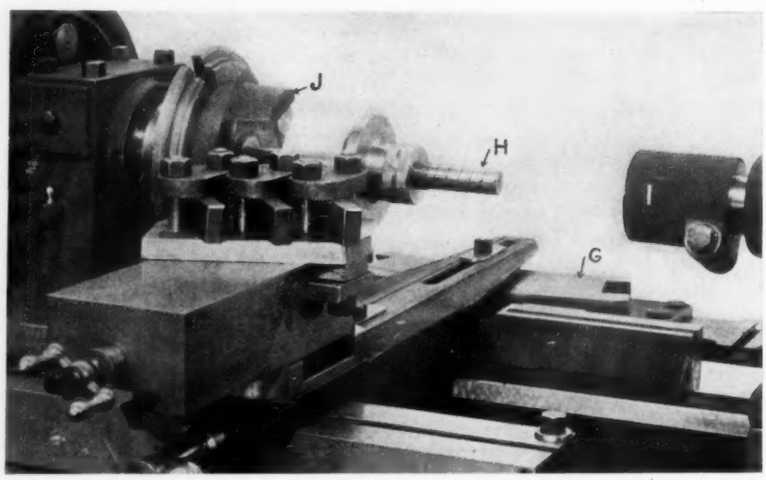


FIG. 11—RIGGING FOR TURNING AND CROWNING CONE PULLEYS

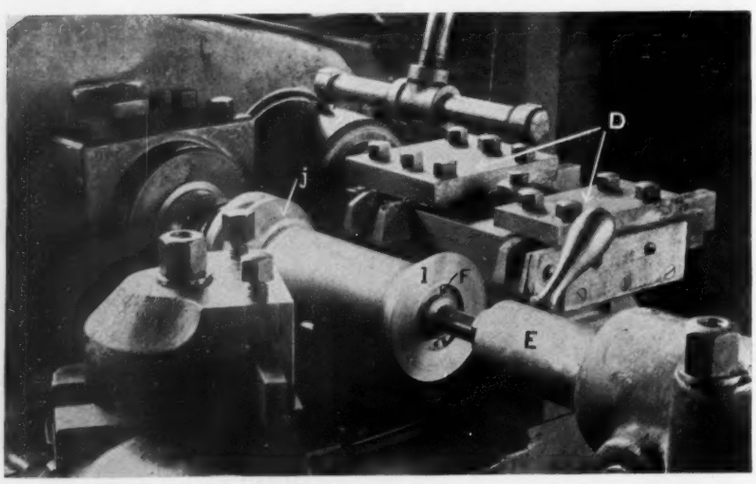


FIG. 10—TURNING DOUBLE BEVEL PINION WITH GANG TOOLS

as shown in Fig. 1, is peculiarly well adapted. The small shaft is 28 inches long and is turned from 0.50 carbon steel bar stock, 2⅜ inches in diameter. The lathe time to turn this shaft all over, face, square and neck the shoulders, and cut the oil grooves, leaving the shaft 0.015 inch large ready to be finished on the grinder, is 21 minutes each in lots of 50. The other shaft is 33¾ inches all-over in length and is made from 0.35 carbon steel bar stock, 2¼ inches in diameter. It is turned all over except the largest diameter in the center, 3¾ inches long, which is left full size of the stock. Time for the lathe work, including turning, oil-grooving and squaring the shoulders, leaving 0.015 inch on the turned diameters ready to grind, is 18 minutes each in lots of 50.

All diameters on these shafts are

obtained almost instantly and quite accurately by aid of the diameter stops. The variation above or below size does not exceed 0.002 inch. The shoulder positions are automatically located by the length feed stops within 0.002 inch.

The former time for turning these same armature shafts on a plain engine lathe, without the multiple stops and connected compound and plain rests, was a trifle over twice the present time. The difference represents the saving effected by the elimination of all hand calipering of diameters and scaling for shoulder positions. Savings of this sort are commonly effected on similar parts when manufactured in quantities.

Fig. 2 shows an 18-inch lathe with special equipment set up for turning and boring automobile hubs. One of these hubs is held in the chuck ready for the first operation and two other hubs are lying on the floor.

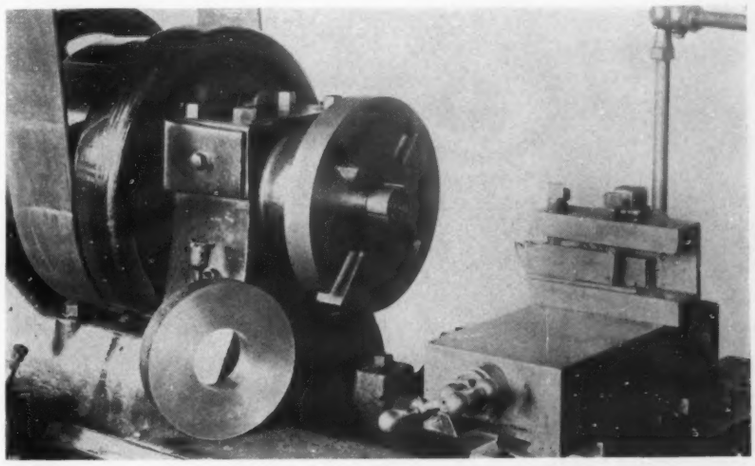


FIG. 13—SECOND OPERATION ON GEAR BLANK—FACING OTHER SIDE

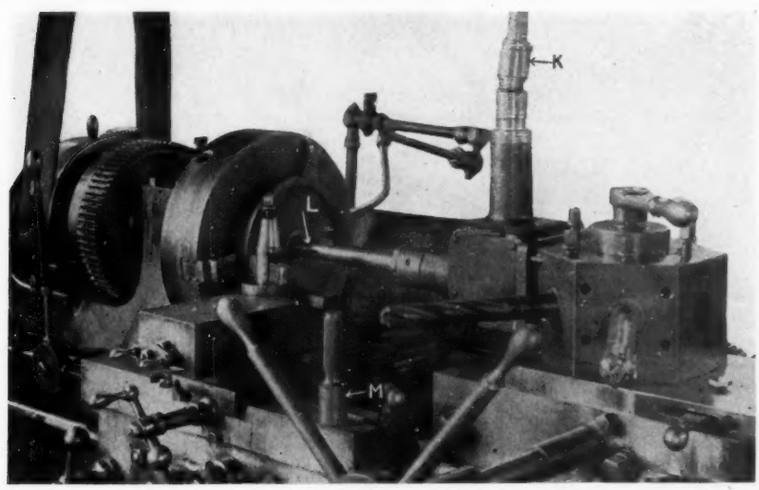


FIG. 12—FIRST OPERATION ON GEAR BLANK-BORE AND FACE ONE SIDE

The turret operations comprise boring a straight hole through the hub with a four-lip drill, boring the seat for the ball cup and reaming the seat for the ball cup. While these turret operations are being carried on, the tool in the compound rest faces the end of the hub, thus completing the first operation.

To perform the second operation the hub is turned end for end and the reamed portion is mounted upon an expanding straight mandrel in position as shown in Fig. 8. Before starting the second operation the holes in the flange of the hub have been drilled so that a pin entering one of these holes acts as a driver. The turret operations then performed are boring the seat for the ball cup and reaming the seat for the ball cup. While the turret tools are performing these operations the lathe tool is facing the flange and turning the different diameters of the barrel of the hub.

The multiple stops for length and cross feed correctly locate the carriage positions to give the thickness of flange and also provide correct setting of the cross slide to give the different diameters on the barrel.

These hubs measure 5½ inches in diameter across the flange, 2⅛ inches diameter of barrel and 5⅛ inches overall in length. The lathe time for turning out one of these hubs complete is 5¼ minutes. The speed with which these hubs are turned out is due to a combination of the advantages of the stops, the performing of boring and turning operations

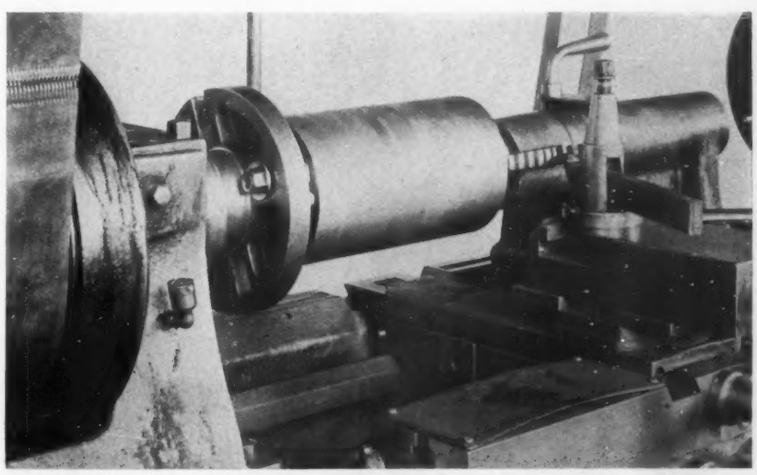


FIG. 14—THIRD OPERATION—TURNING OUTSIDE DIAMETER

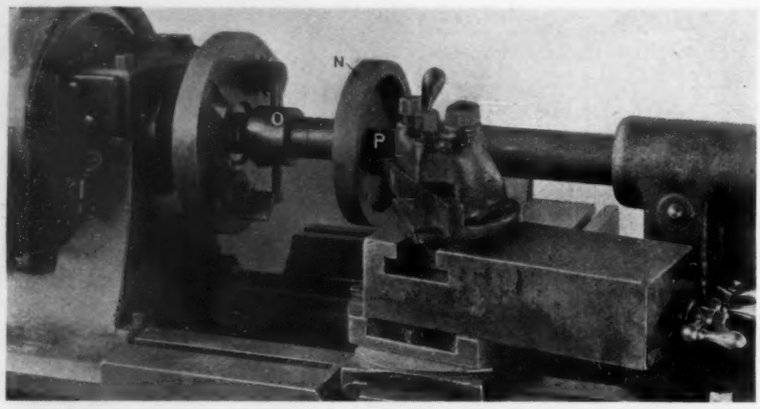


FIG. 15—TURNING APRON FRICTION ON DEAD ARBOR

simultaneously, and the rigidity with which the hub is held for the machine work.

The use of a special fixture for turning the pins of crank shafts is illustrated in Fig. 9. For such work it is necessary that the center line of the crank shaft be offset from the line of the lathe centers by an amount equal to the throw of the crank. This is accomplished by a special chuck on the face plate and a special chuck on the tailstock which grip the crank shaft in the desired eccentric position. Before delivering the crank shaft to the lathe for turning the pins, the bearings and the flange, which are on the center line of the crank, have first been turned between centers in another lathe.

The cross slide is made special so as to carry front and back tools on the same slide. Locking plungers are provided for accurately lining up the face plate and tailstock chucks before clamping the crank shaft in position. After clamping the crank shaft in the chucks, the lathe operations, consisting of turning the cylindrical portions of the pins with the front tool, and filleting the ends of the pins with the rear tools, are performed. Two tools are held in the rear holder, spaced the proper distance apart to exactly measure the length of the pin.

In Fig. 9 the cross slide is shown drawn forward to bring the rear tools into action for filleting the pin. The lug on the cross slide is in contact with one of the stops on the diameter stop bar, *B*, to locate the proper diameter which is being cut by the fillet tools. The proper position of the carriage for this operation is determined by a notch in the spacing bar, *C*.

The three examples of lathe work just mentioned illustrate Lodge & Shipley lathe operations as performed in other shops. They are shown here because they illustrate certain classes of operations not called for in the manufacture of the engine lathe. All of the examples of work which we will next consider are taken from the regular shop practice in the Lodge & Shipley plant.

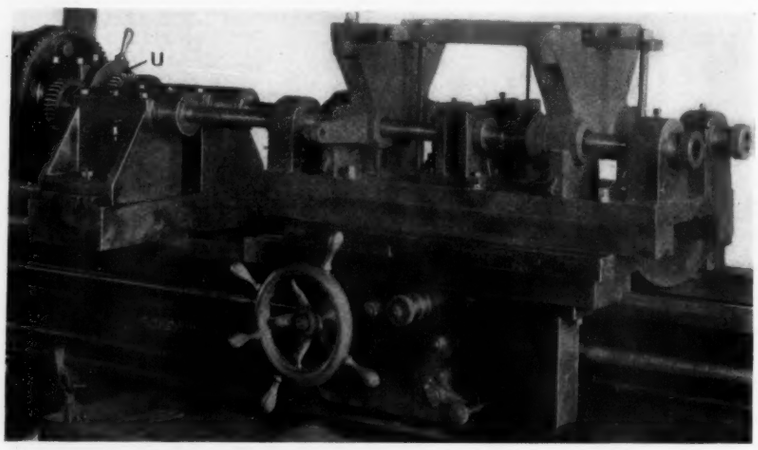


FIG. 17—BORING A COUNTERSHAFT FRAME

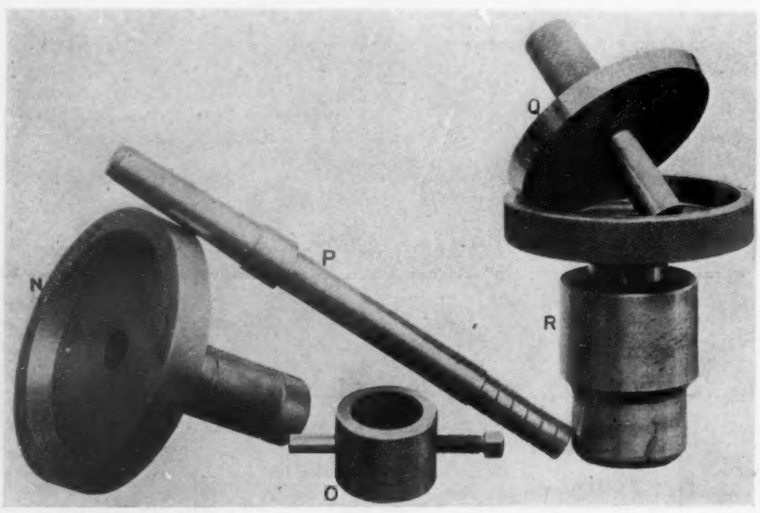


FIG. 16—FINISHED APRON FRICTION, ARBOR AND GAGES

To illustrate the manner in which the notches on a spacing bar correspond with the shoulder positions on a finished piece, the spacing bar and the finished job are shown side by side in Fig. 4. This is the traverse friction stem for a 27-inch lathe. The unusual points are the accuracy with which the lathe work is done, the amount of stock removed, and the short time consumed. The length of the rough stock blank is 12⅜ inches; diameter, 2½ inches; weight, 17¼ pounds, and the material, 0.30 carbon steel. The finished piece is 12¼ inches long, 2⅜ inches in diameter at the largest portion, and

the weight, 4¾ pounds. The lathe time complete for facing the ends, facing and necking the shoulders, and turning all diameters with proper allowance for finishing on the grinder, is 18 minutes each in lots of 50.

Fig. 6 shows a double bevel pinion for a 24-inch lathe. Reading from right to left it is shown first in the rough stock; second, the completion of the first turning operation; and third, turned ready for grinding.

Fig 10 shows the lathe as set up when turning one of these pinions. The special tool equipment is particularly helpful in securing rapid production. The four gang tools in the rear holder, *D*, are spaced the proper distance apart to neck into the work for locating the various shoulder positions, and also for facing off one end of the work. The diameter stops used in giving the correct depth of cut are in this case mounted on the further side of the bridge of the carriage, and do not show in the illustration.

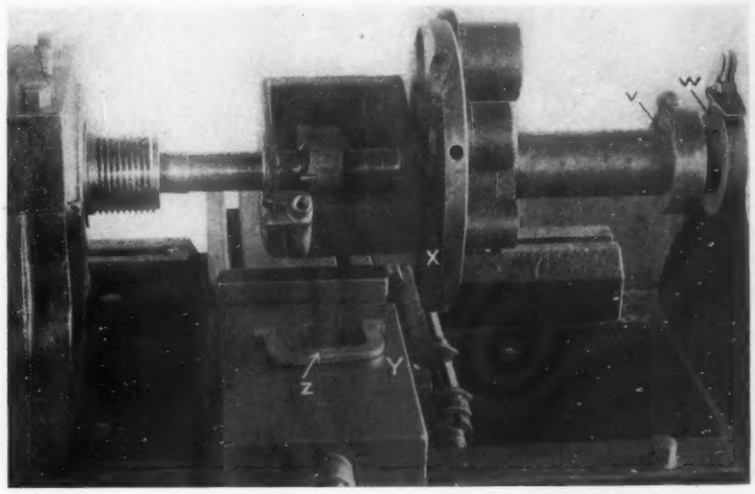


FIG. 19—FACING BOSSES INSIDE OF QUADRANT BOX

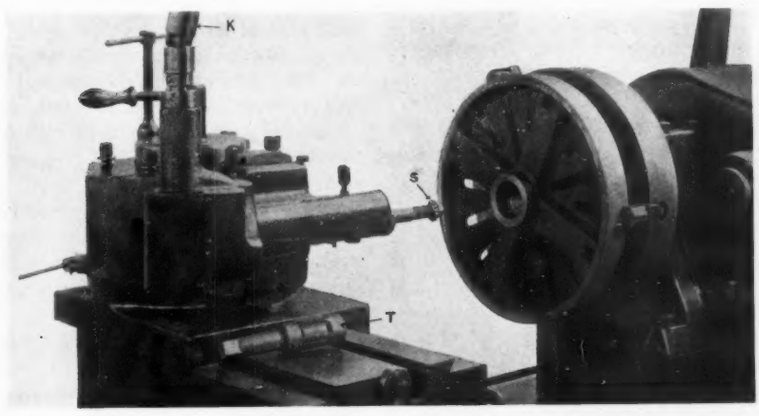


FIG. 18—MILLING INTERNAL THREAD IN FACE PLATE

The gang tools are first fed directly into the work to the full depth of cut, all operating simultaneously; next the cross slide is moved back, which withdraws the back tools and at the same time brings the front tool into action.

The finished parts in Fig. 6 clearly show the bevel surfaces in which the gear teeth are subsequently cut at the ends of the pieces. By means of a specially formed turning tool in the front holder, these bevel surfaces are both obtained at one operation. The rear end of this tool is shown in Fig. 10 projecting from the tool block of the compound rest. This tool is formed with two straight-line cutting edges meeting to form a sharp V of about 90 degrees included angle. This tool is so set that the left hand cutting edge gives the correct angle for the left-hand bevel surface, *j*, and right hand cutting edge is at the proper angle to form the bevel surface, *l*, at the right hand of the work. This combination turning and forming tool is first fed straight into the groove which has been formed by one of the gang tools in the rear holder near the right hand end of the work. The carriage has previously been located by the length feed stop so that the tool is in the proper position to give the correct location of the bevel surface, *l*. The proper length feed is then engaged, carrying the tool straight across the work until the next stop trips the feed, leaving all parts in the position shown in Fig. 10. No further operation is necessary to get the correct angle for the next bevel surface, *j*, because the cutting edge of the tool is so placed that it always cuts at this very angle.

This double bevel pinion has been

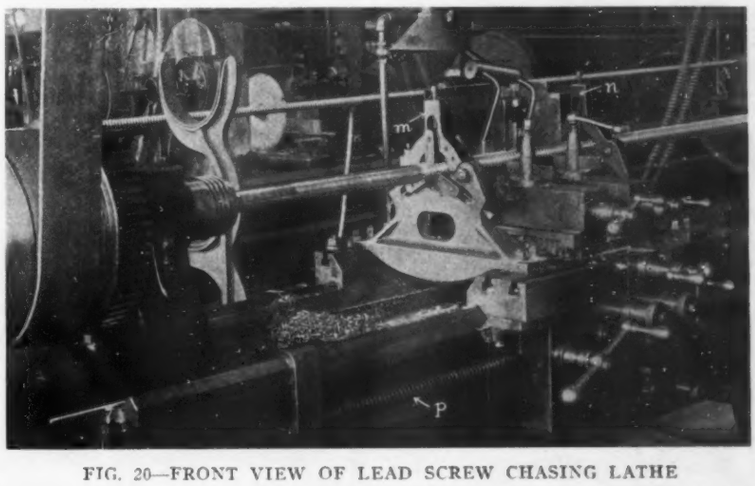


FIG. 20—FRONT VIEW OF LEAD SCREW CHASING LATHE

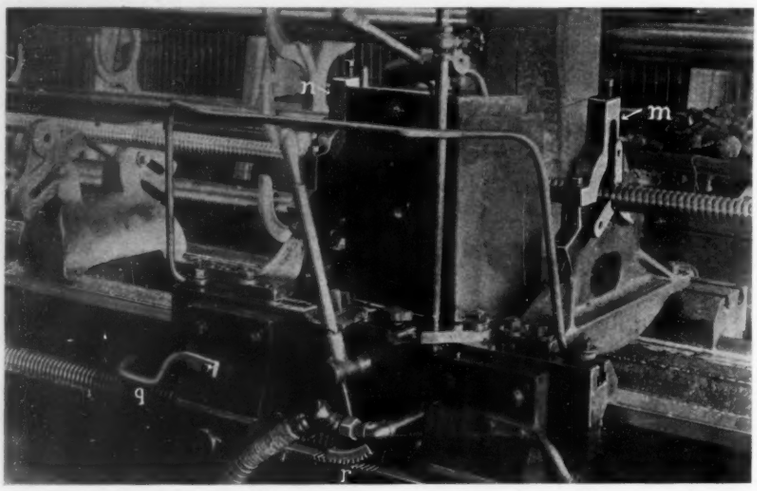


FIG. 21—REAR VIEW OF LEAD SCREW CHASING LATHE

bored axially before it is delivered to the lathe, so that for the turning it can be mounted on a roller arbor, *F*. This roller arbor, instead of revolving on a tailstock center, revolves in a bushing inside of the tailstock spindle, *E*. For quick handling of the tailstock spindle, when moving it in and out to cover the journal end of the roller arbor, the regular feed screw has been removed and instead the handle shown has been substituted so that when the locking clamp is released, the spindle is free to be moved quickly in or out by hand.

The rough stock, as delivered to the lathe, is 0.30 carbon steel, 9½ inches long and 3¾ inches in diameter, weight 22¼ pounds. At the finish of the first turning operation this blank has been faced to 9⅜ inches length, has been reduced in diameter at the long portion in the center to 2 7-16 inches and weighs 7¾ pounds. To remove this quality of metal, to locate the correct diameters and shoulders, and to obtain the proper angles for both bevel surfaces requires only 13 minutes per piece in lots of 200.

This part was formerly made from a steel casting. The material cost was then a trifle less, because the casting was made to approximately the form of the finished piece; however, the machine work on the steel casting took about four times as long as at present. Thus, in this case, it is excellent economy to use bar steel for the raw material, even though nearly two-thirds of it is cut up into chips.

The second lathe operation performed in preparing this part for the grinder is not shown, as it illustrates nothing out of the ordinary. What this second operation consists of may be clearly seen from a comparison of the parts shown in Fig. 6.

The design of the journal bearing just mentioned for supporting the live end of an arbor in the tailstock spindle, is more clearly shown in Fig. 11. The live end of the arbor, *H*, is provided with a spiral oil groove; this journal runs in a bushing, *I*, inside of the tailstock spindle. This gives a much stiffer support to the end of the arbor than could be possibly afforded by a tailstock center and at the same time allows more thorough lubrication.

The special equipment shown in Fig. 11 is a rigging for turning and crowning a three-step cone pulley. The pulley, which is not shown in the illustration because it would conceal the driving mechanism, is slipped over the arbor so that the driver, *J*, enters the large end of the cone and engages one of the webs. This driver is attached to the spindle nose. The knurled collar is screwed up to hold the pulley in position against the driver. Three turning tools are arranged in a gang on the compound rest so that cuts are taken over all three steps of the cone pulley at one time. A special crowning attachment, *G*, is fastened to the back of the carriage to give the necessary crown to each step of the pulley. This attachment consists of a groove made in the form of an arc of a circle; a sliding shoe works in this groove. The bracket carrying the groove is clamped to the bed of the lathe, while the sliding shoe is attached to the cross slide. As the carriage is moved forward by the power length feed, when turning the steps of the pulley, the cross slide is automatically moved gradually out and then gradually in, thus causing the cutting tool to travel in a circular path, and producing the desired crown on each step of the pulley.

Steel change gears are used in all Lodge & Shipley lathes. This necessitates machining so great a quantity of blanks that highly specialized lathe equipment for the different operations, as shown in Figs. 12, 13 and 14, is used to advantage.

The first operation, Fig. 12, is to grip the blank in a three-jaw universal chuck, drill, bore and ream the hub, and face one side of the hub and rim. The first turret operation is to drill a straight hole through the hub with a four-lip drill which gives nearly the finished size. The boring bar, *L*, is next brought into action; this bar is rotated in the opposite direction to the lathe spindle, being driven by means of a separate countershaft through a universal coupling, *K*. The forward end of the boring bar is supported in a ball bearing guide bushing inside the lathe spindle. This insures a true bored hole. Before starting the boring cutter, the hub has been faced with the tool held in the compound rest. The facing of the rim with the same tool is carried on simultaneously with the boring of the hub. The revolving of the boring bar in the opposite direction to the work gives the proper

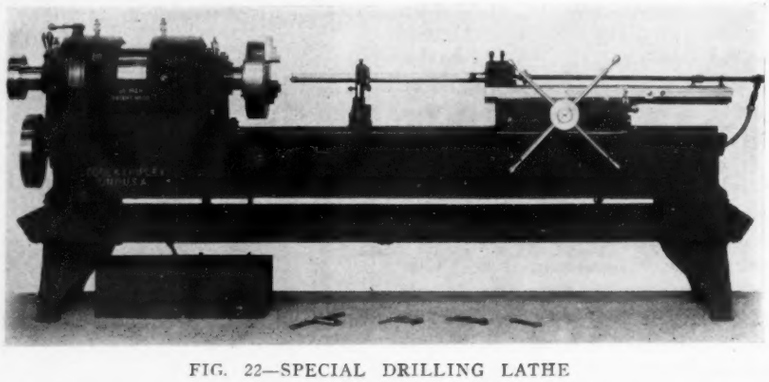


FIG. 22—SPECIAL DRILLING LATHE

surface speed at each of the two different diameters being machined. After the boring is completed the speed of the work is reduced and the hole sized by the machine reamer in the turret. A standard plug gage, *M*, is used to test the accuracy of each reamed hole. Every gear must be finished to plug gage standard.

The gear blank is next key-seated and delivered to the lathe shown in Fig. 13 for the second operation. The reamed bore of the gear blank is slipped over the expanding stub arbor, with the finished face of the gear tight against the face plate. A lever on the end of the headstock is then thrown back, which expands the arbor and draws back the blank squarely against the face plate. The friction between the arbor and the bore is sufficient to drive the smaller gears. Larger gears are positively driven by a key on the stub arbor, engaging the key-way in the hub. This second operation consists of facing the exposed side of the hub and rim. Two tools in the compound rest are used for this facing; one is a roughing tool, the other a finishing tool. They are placed side by side so that at one pass of the cross slide the blank is roughed and finished. To obtain the proper setting of the carriage to give the correct thickness of the blank, the carriage is brought against a positive stop before the power cross feed is engaged.

The third operation consists of turning the outside diameters of the blanks, as shown in Fig. 14. Nine of these blanks are mounted side by side on an arbor. A special gage, consisting of a series of steps, is slipped over the tailstock spindle, and by bringing the turning tool up against a hardened steel plug inserted in one of these steps the proper setting of the tool is obtained to give the correct diameter.

The advantages of this specialized engine lathe equipment for turning gear blanks, over an automatic or special machine, are the accuracy with which the standard size of bore is obtained; the exactness with which the gear is faced at right angles to the bore; the parallelism of the two faces; the true outside diameter obtained by finally turning the gear blanks on an arbor, and the speed with which the finished blanks are produced.

It is absolutely essential that the conical friction surface inside the apron friction gear be perfectly concentric with the bore, as otherwise a true contact between the two frictional surfaces would not be secured. Figs. 15 and 16 illustrate the method used in turning these frictions for insuring a frictional surface absolutely true with the bore regardless of whether or not the arbor itself may be perfectly true. This necessitates a *dead* arbor, that is, one which does not revolve.

Use of Dead Arbor for Turning Apron Friction

The taper shank of the arbor, *P*, is inserted into the tailstock spindle instead of into the headstock spindle. The friction gear, *N*, which is to be turned is slipped over the arbor, on which it is a good running fit, leaving the gear free to revolve upon the arbor. A driver, *O*, is fitted over the hub of the gear and secured to it by a set screw.

The tailstock spindle is arranged for quick in and out traverse by hand without tailstock screw as already explained in connection with Fig. 10. The end of this arbor which projects from the tailstock is provided with spiral oil groove and, when the tailstock spindle is extended, enters a guide bushing within the live spindle of the lathe. This places the parts in the relative positions as shown in Fig. 15, ready to commence the turning operation.

A projecting arm on the driver engages a dog on the face plate. The revolving face plate dog carries the driver with it and thus causes the friction gear to revolve directly upon the arbor. The arbor remains stationary, as it is firmly held in the taper hole of the tailstock spindle. The friction gear is thus revolved on its own bore and, therefore, the frictional surface is bound to come out true with this bore, regardless of the accuracy of the arbor on which the work is mounted. Nevertheless, extreme care is taken in handling the arbor itself so that conditions will be just as favorable as possible.

The compound rest is swiveled, as shown in Fig. 15, and set so that the travel of the slide is in the direction to give the correct bevel to the friction surface. The original setting of this compound rest slide at the proper angle is accomplished by special gage.

In Fig. 16 are also shown the gages by which all finished frictions are inspected. The male portion, *Q*, of this gage is used for testing the accuracy of the female frictions; the female portion, *R*, of the gage is used for testing the male frictions. All of these parts are turned strictly to gage and the mating frictions are never tried one with the other until the apron is assembled. The accuracy of this lathe work is such that the frictions thus turned are absolutely interchangeable and no difficulty is experienced in assembling the parts thus machined.

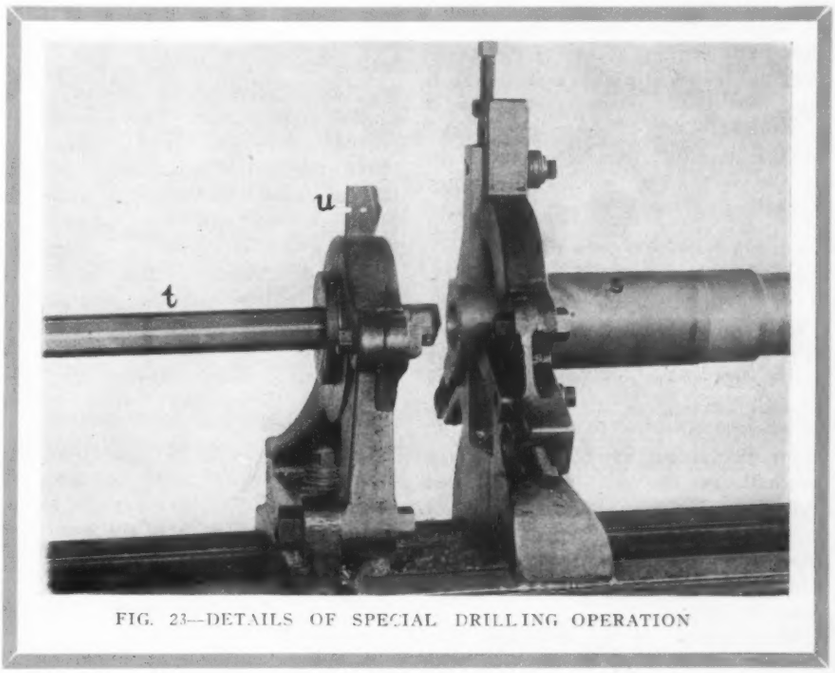


FIG. 23—DETAILS OF SPECIAL DRILLING OPERATION

The old style solid arbor which is either driven or forced into the piece to be turned is almost unknown in the Lodge & Shipley plant; instead, special designs of arbors, several of which we have already mentioned, are used for special cases.

The roller arbor used for the job, shown in Fig. 10, is made perfectly straight and is a snug fit for the bore

of the double bevel pinion. One side of this arbor is flattened for its entire length, and a long roller is placed in the space between the flat and the inside of the job being turned. The pressure of the cut, tending to rotate the work on the arbor, wedges the roller tighter and tighter between the arbor and the work. This gives a very secure drive and is entirely satisfactory for work such as this in which the thickness of metal is sufficient that no matter how great the wedging action, it cannot distort the shape of the hole.

Expanding arbors, as shown in Fig. 13, are used for holding short work where there is no possibility of the pressure from the arbor to spring the work out of shape.

The bronze bushings used in the countershaft pulleys require a different type of arbor, because the walls of these bushings are comparatively thin. The turning arbor for the bushings is made straight and of such size that the bushings slip over it easily. A notch is cast in the end of the bushing. A short projection at the face plate end of the arbor engages this notch to act as a positive driver.

Turning and Facing.

In turning work on an arbor between centers it is customary to run the tailstock end of the arbor in a journal bearing as already described in connection with Fig. 11. The obvious advantages of this are that the journal can be well lubricated, and that the support afforded to the arbor is very much stiffer, which prevents the danger of spoiling work by an arbor springing away from the tailstock center.

For turning or facing where the finished surfaces must run true with the bore to the closest limit of accuracy, a dead arbor is used and the work revolves directly on the arbor as already shown in Fig. 15. A similar rigging is used for turning certain cone pulleys.

By means of the special attachment shown in Fig. 17, a regular engine lathe is used to splendid advantage as a two-spindle horizontal boring mill. The operation shown is that of boring the frame for a countershaft of a patent head lathe.

A fixture placed over the nose of the lathe spindle carries gearing, *U*, which drives the two boring bars. A jig on the lathe carriage is provided with suitable brackets and clamps for receiving the countershaft frame, and also has guide bushings for supporting and guiding the two boring bars at both ends. After the proper setting has been made the power length feed is engaged, which traverses the carriage past the boring cutters.

Each boring bar carries two cutters, one for the right hand bearing and the other for the left hand bearing. Thus all four bearings in the countershaft frame are bored at the same time.

Engine Lathe for Internal Thread Milling

Face plates are chucked as shown in Fig. 18, for facing, turning, boring and threading the hub. These operations are performed by different tools held in the turret on the carriage. The illustration shows the face plate after these operations have been completed. The threading has just been done with the milling cutter, *S*. This cutter is driven from a separate countershaft through a universal joint, *K*. For doing this internal thread milling the speed of the lathe spindle is greatly reduced by means of a special countershaft. The carriage is geared up in the usual manner to chase the pitch of thread desired, just as would be done if a single point chasing tool were used. The cutter, which is revolving in the opposite direction to the work, is brought into action and at one cut mills the thread to within 0.005 inch of finished size. After the milling, a hand tap, *T*, is put through the hole to finally bring the thread up to standard size.

On the inside of the quadrant box are bosses which must be faced to give true surfaces at a certain standard distance apart. Fig. 19 illustrates the method used to mill these surfaces and shows how stops are provided to give the proper distance between the two bosses.

A milling cutter is mounted on an arbor and the quadrant box is a running fit over this same arbor. The arbor is driven from the lathe spindle, while the quadrant box is held against rotating. The quadrant box is fastened to the tailstock spindle, together with the stop collar, *V*, and the stop plate, *X*. These parts cannot revolve, but can be given a longitudinal movement by means of the tailstock screw to feed either boss against its side of the milling cutter. The arbor carrying the milling cutter is journaled inside the tailstock spindle.

Facing Left Hand Boss

In facing the left hand boss the tailstock spindle is fed out until the stop plate, *X*, makes contact with the near surface, *Y*, of the compound rest. The carriage has previously been positively locked in the correct position so that this contact forms a positive stop to the left.

To face the right hand boss, the tailstock spindle is fed in until the stop collar, *V*, strikes against the end, *W*, of the tailstock nose. This forms a positive stop to the right.

The relative positions of the carriage and the stop collar are so located that the distance between the two bosses inside the quadrant box, as determined by these stops, will be correct. A special gage, *Z*, is provided for calipering and testing the distance between the two finished bosses.

Two special lathes are used for chasing lead screws. One of these lathes is illustrated in Figs. 20 and 21. The headstock is made special, having a large hollow spindle, with draw-back collet for gripping the work. Only a portion of the lathe is shown in the illustration, as it has a long bed, giving sufficient capacity to chase screws up to 24 feet in length at one setting. Longer screws can be handled by allowing them to pass through the hollow spindle.

Chasing Precision Screws

Two chasing tools are used, each carried in its own holder on an independent cross slide. Each slide has independent in-and-out adjustment by cross feed screw with micrometer collar. Two special follow rests, *m* and *n*, Figs. 20 and 21, are bolted across the front and rear wings of the carriage, one leading the cutting tools by a short distance, and the other following them. There is also a steady rest supporting the work from the back, between the two cutting tools.

The screw, *p*, Fig. 20, on the front of the bed is used only for the quick return of the carriage. The precision lead screw, *q*, Fig. 21, which is used for the forward traverse of the carriage during the chasing, is located on the back of the bed. This precision screw is 2¾ inches in diameter, and is supported through its entire length by a series of shoes. Each shoe is 12 inches long, and they are spaced at intervals of about 20 inches from center to center; thus there is no possibility for an error to be introduced by sagging of the precision screw, either from its own weight or from the pressure of the half-nuts against the threads when pulling a cut.

Two half-nuts, one attached at either end of the rear carriage, can be raised or lowered, out of or into engagement with the threads of the screw, by means of the cam plate, *r*, Fig. 21, which in turn is operated from the vertical lever. The lower end

of this lever is made in the form of a segment, having teeth which engage rack teeth in the top of the cam plate. The cam plate can be operated directly from the vertical lever at the back of the lathe, or from a ball crank at the front of the lathe which is connected by a shaft to this same lever. After the carriage has traversed the length of one cut to the headstock end, the tools are withdrawn, the half-nuts are drawn out of mesh with the precision screw, and the quick return screw, *p*, Fig. 20, is engaged. This screw is driven from an independent countershaft and quickly returns the carriage to the tailstock end of the bed, ready to begin the next chasing-out.

The countershaft which drives this quick return screw is provided with forward and reverse pulleys, so that quick traverse of the carriage may also be obtained toward the head end of the lathe, when necessary to make adjustments for cuts or for any other purpose.

Fig. 22 is a general view of the lathe used for drilling the axial hole through each lathe spindle. One end of the work to be drilled is held in the chuck; the other end is supported by a steady rest not shown in this illustration. One end of the drill is clamped to the sliding block, and the other end is supported in the guide rest. The sliding block carrying the drill can be traversed either by the hand pilot wheel, or by a power feed mechanism on the back of the bed.

A detail view of the deep hole drilling operation is shown in Fig. 23. The end of the lathe spindle, *S*, is supported in the steady rest, while the drill, *t*, has just been withdrawn after having completed the hole. The body of this drill is made of vanadium steel to withstand the torsion, and has a brass tube inserted along one side for discharging a supply of cutting lubricant at the drill tip. This lubricant washes the chips out through a straight flute milled in the opposite side of the drill.

The drill tip is an inserted cutter of high speed steel. One of these cutters, *u*, is placed separately on top of the guide rest to more clearly show its form, as the one which is already in place in the body of the drill cannot be distinctly seen. The hole in the center of the cutter receives a taper pin passing through the body of the drill, to hold the cutter securely in place and keep it central. The notch in the back of the cutter is for locating it on the table of the grinder when sharpening.

The work being drilled revolves, while the drill itself remains stationary except for the in and out traverse. Under such conditions, the drill tends to follow the axis of rotation, so that a true hole is produced without tendency for the drill to run out sideways.

The variety of operations we have just considered indicate, what can be accomplished on the engine lathe in a manufacturing plant. Usual lathe operations, such as plain chucking work and regular turning between centers, have been purposely omitted. No mention has been made of heavy roughing cuts, which are merely a question of power of the lathe and durability of the cutting tool.

In some factories special machines are used for operations similar to some here shown. For example, there are special lathes designed for bar work; a comparison of the present engine lathe time on the armature shafts, shown in Fig. 5, with the time required to do similar work on any other type of machine, is highly interesting as showing the great value of the engine lathe equipped with multiple stops and connected compound and plain rests. To use another example, automatic machines are often employed for turning gear blanks. But considering both the accuracy of the finished blanks and the speed at which they are produced, the engine lathe equipment shown in Figs. 12, 13 and 14 excels any other method which has yet been tried for this particular work.

Aside from the quality of the work produced, the engine lathe has the advantage of ready adaptability to a comparatively wide range of work. Another consideration is that the engine lathe requires just a few simple and inexpensive forged tools for all work, instead of elaborate tool equipments for each particular job.

Continued Decline of Southern Pig Iron Prices

By F R Lindsley

IN STUDYING the history of the southern pig iron market for the past 12 months, we find that the year 1911 was not subject to the sharp fluctuations in prices that have obtained in most years, but to the contrary has for the most part moved along quiet lines, actual figures indicating a decline of but $1.25 during the entire period. In reality, this should be $1 instead of $1.25, as the latter quotation obtained but a day or two, after which the market quickly returned to a $10 Birmingham basis. The decline during 1910 was $3 per ton. During the closing months of 1910, the sentiment gradually began to take form that the time had about arrived for producers of the south to make some move looking to the curtailment of production, as this logically appeared to be the solution of the problem of supply and demand that was then confronting the trade. There were rumors that this plan was to be generally pursued, and that while no concerted action had been taken in the matter, it was tacitly understood that developments of this kind would result. It appears from later developments that this was more rumor than anything else, as no general action was taken and that merely a stack here and there was blown out, as the policy of the furnace interests demanded at the time. This has continued throughout most of the year excepting perhaps the last two months, when the heavy buying movement of the large cast iron pipe companies fairly cleaned southern yards of a large portion of available iron, at the same time resulting in materially stiffening prices and giving the market a better and firmer tone.

January, 1911, opened with conditions practically the same as marked the closing of the previous year, with southern iron quotable at $11, Birmingham, with indications that before long it would go lower. Conditions did not appear very satisfactory, and no general buying of importance resulted. The following month gave little indication of being better, as a stagnant condition of affairs was known to exist throughout the entire central west just then, and iron was in light demand. The largest transaction that was reported at this time was a round block of low grade foundry that was taken by the leading cast iron pipe company. March fol-

lowed closely in the wake of its predecessor, and while there appeared a certain amount of hesitancy on the part of buyers to come forward for their requirements as a result of the railroad freight rate decision, the strength of the market indicated little impairment and no radical change was experienced. The southern situation appeared to be growing stronger and shipments from the Birmingham district were very satisfactory indeed. About this time, Chicago territory developed quite a buying movement for southern foundry grades, and the whole situation appeared to be a little brighter. Established quotations continued on an $11 basis, with nothing to indicate that any sales had gone at a lower figure. Reports at this time indicated a great scarcity of the lower grades, particularly No. 4 foundry, which it was said was almost unobtainable. Leading harvester interests were thought to be quietly buying large blocks of iron during April, yet the general trend of conditions was toward dullness.

Notwithstanding the low prices that were being named, it appeared to be next to impossible to interest consumers, who were little inclined to cover for any extended delivery. Prices again declined, going to $10.50, Birmingham, during May, with statistics showing 265,000 tons piled on southern yards. Buying was somewhat erratic, and trade continued quiet and unsettled. During the early part of June, several merchant furnaces were blown out, which it was thought would have a beneficial effect, and place consumption and production more nearly upon a parity. A little later, a further drop of 50 cents per ton failed to stimulate buyers to any extent, the prevailing quotation then being $10, Birmingham. In July, several of the leading cast iron pipe makers were again in the market and bought heavily, reports at the time indicating that established quotations were slightly shaded. At this time, a slightly better tone was evident, in that a number of consumers were taking some interest in forward deliveries and would probably buy, if things could be satisfactorily arranged. Sales made, however, were for the most part in small lots, yet in the aggregate represented considerable tonnage. During August, southern furnace interests advanced the price 25 cents, which had a tendency to check any little buying movement that might have been developing. Notwithstanding this, it was evident that some $10 iron was still available in the Birmingham district. During the closing days of the month, the latter price practically disappeared, excepting perhaps where the business was particularly desirable and in round lots. Furnace interests were endeavoring to maintain a $10.25 quotation, which for a short interval appeared to be successful, but it was short lived and southern pig iron became lifeless, as a result.

September statistics fully verified the above statement, and it was generally conceded that the attempt made on the part of the furnaces to raise prices was untimely and ill-advised. Prices once more went to $10, producers apparently concluding that any increase over this figure must be abandoned, if they wanted to sell iron this year. During October, the situation continued quiet and little new business found its way to furnace books. On the other hand, reports indicated that foundries were taking contract iron freely and that stocks as a rule were at a minimum.

Monthly Average Prices of No. 2 Southern and Gray Forge.

	Southern No. 2 Birmingham.	Gray forge Cincinnati.
January	$11.00	$13.35
February	11.00	13.25
March	11.00	13.15
April	11.00	13.05
May	10.75	12.90
June	10.25	12.50
July	10.00	12.05
August	10.05	12.05
September	10.10	12.05
October	10.00	12.00
November	10.00	12.00
December	10.00	12.00

Just at this juncture, the country was startled by the news that the government had taken issue against the leading steel interest of the land, the opinion being that such action would certainly exert a disastrous and depressing effect upon general market conditions. To a certain extent, this feeling has subsided, yet will not be wholly eradicated and confidence fully restored until the matter is finally settled. November buying was limited almost entirely to small lots for immediate consumption, furnace interests evidencing an unwillingness to quote for forward delivery at prevailing prices. At this time, one of the large melters in eastern territory renewed a contract calling for 18,000 tons of southern foundry grades, delivery of which was to be made at the rate of 3,000 tons per month. Cast iron pipe companies were again becoming aggressive, and in need of iron, and it is said practically cleaned several southern furnace yards of available tonnage, at the same time establishing the minimum price of the year of $9.75, Birmingham. The impetus thus given to the market by these large purchases, however, was such, that it was impossible to continue buying at this low figure and the market quickly rebounded to a $10 basis, at which point it appears to be fairly well established.

It would, perhaps, be ill-advised to attempt to speculate as to the future, yet it may be pardonable to say that, so far as the horizon may be scanned, there are no signs that give undeniable assurance that prices will be materially higher three months from now than they are today.

Steel Ingot Molds

The use of steel for making ingot molds in Germany has not been attended with very encouraging results, according to A. Thiele in *Stahl und Eisen*. After a few heats, the molds deteriorate and they become useless for further work. The use of different qualities of steel had no effect in overcoming the difficulty, but ultimately the problem was solved by reinforcing the molds externally with I-beam sections, or mine rails, which were cast onto the ingot molds. The rails were cut into lengths of about 27 inches, and were placed lengthwise on each of the four sides of the molds, in groups of three, parallel to each other. The rails were embedded in the walls of the sand molds, in which the ingot molds were cast, in such a manner that the flanges were covered by the molten metal to the depth of from ½ to ¾ inch. The heads of the rails thus protrude on the outside of the finished mold castings, and being air-cooled, counteract the tendency to contraction on the part of the mold when used for casting ingots.

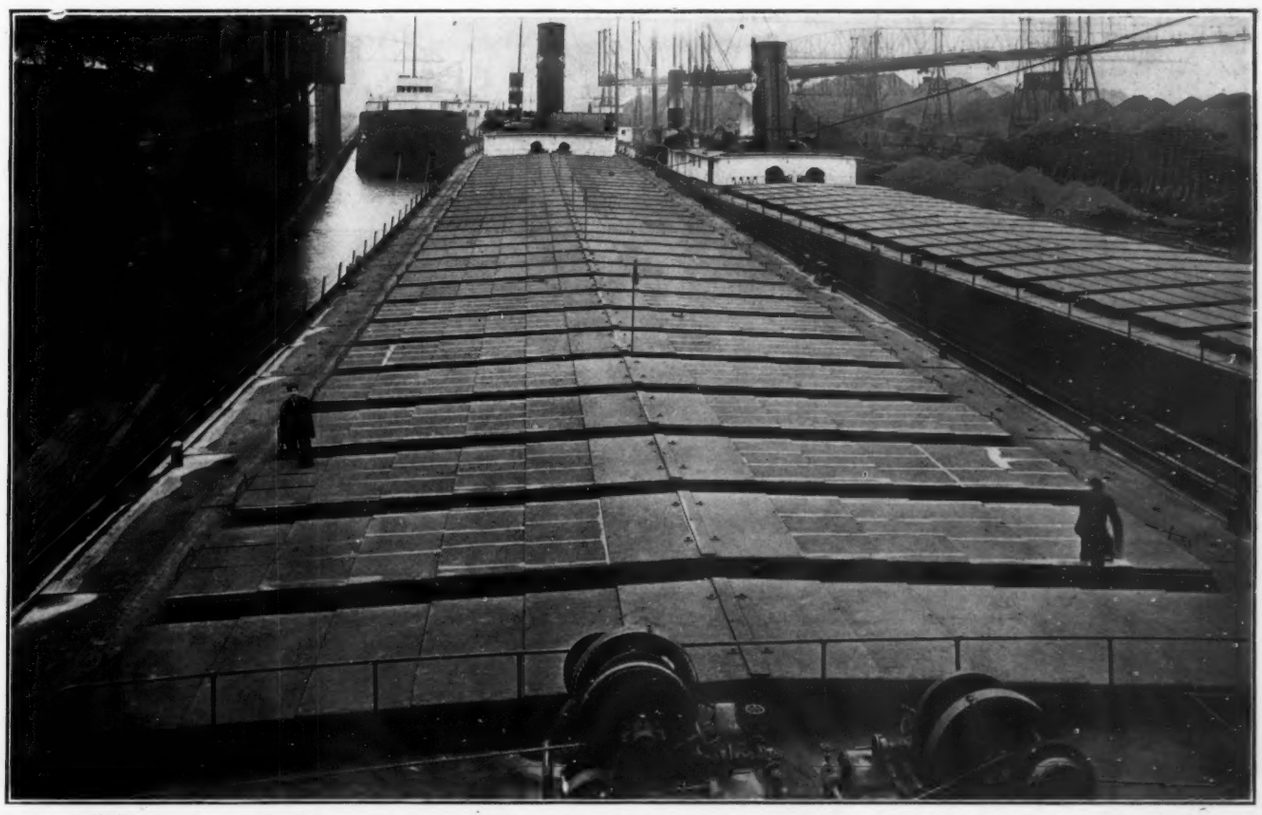
This method of reinforcing ingot molds is patented in Germany, and it is claimed that molds so protected will last about 250 heats. Usually, the lower part of an ingot mold is attacked by the molten steel and enlarged, but it is claimed that is not the case with steel molds, as the lower section remains of the same size throughout their life. In addition to the saving of metal lost from the mold per ton of steel, it is also claimed that the steel molds cost less than those made of cast iron and when worn out are of more value as scrap. Either Bessemer low carbon steel or basic open-hearth is found to be suitable material for their construction. When the molds are in use water-cooling should be avoided as much as possible.

The bulk freighter, Col. James M. Schoonmaker, as she was leaving the Ecorse yard of the Great Lakes Engineering Works for her maiden trip, Oct. 8, 1911

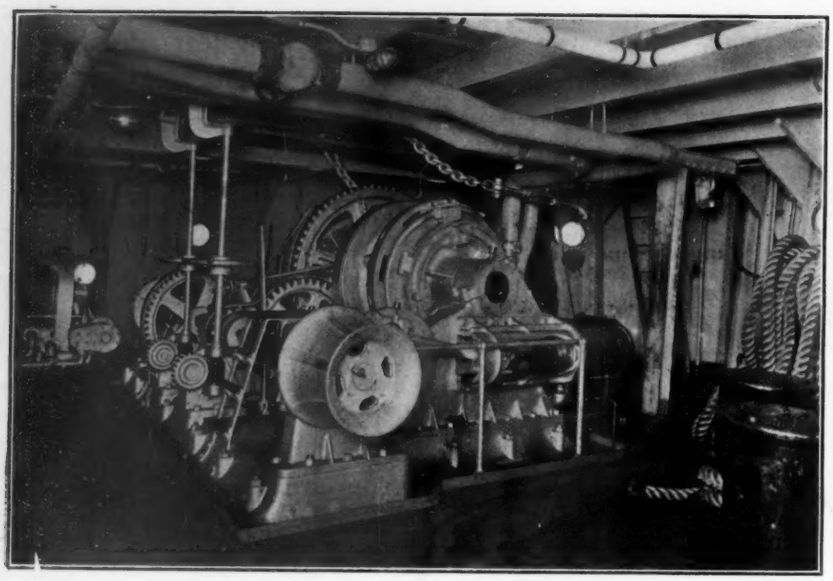
A Great Lakes 15,000-Ton Ore Carrier

By R D Williams

THE trade of the great lakes has made phenomenal strides during the past decade and has constituted one of the wonders of industrial development throughout the world. The increase has been coincident in all directions—in volume of freight moved, in efficiency of unloading appliances and in the increased carrying capacity of the vessel. Ten years ago the average carrying capacity was under 3,000 tons; today the largest vessel can safely carry 12,000 tons. The sound and enormous increase of the trade and the simplicity with which one might enter it tempted the speculative element into shipbuilding, with the result that for the present there exists a surplus of ships. This surplus was in part, however, brought about by the failure of the established interests to adequately discount the advance made in unloading appliances. The efficiency of the unloading machine has added very greatly to the carrying capacity of the ship by making it possible to carry a larger number of cargoes in a given period. For the time being ship building in the bulk freight trade will be confined exclusively to interests that have their own commodities to move. In this connection it is pertinent to pay at-



DECK VIEW OF THE SCHOONMAKER, TAKEN FROM THE FORECASTLE, LOOKING AFT, SHOWING HER 35 HATCHES. THE SHENANGO, 605 FEET LONG, IS LYING ALONGSIDE



WINDLASS ROOM OF THE SCHOONMAKER

tention to the very latest development in the line of bulk freight ship building on the lakes.

The bulk freighter, Col. James M. Schoonmaker, built for the Shenango Steamship & Transportation Co., of which Wm. P. Snyder, of Pittsburgh, is the moving spirit, is not only the largest bulk freighter on the lakes, but is said to be the largest freighter in the world designed exclusively for carrying freight in bulk. She is 10 feet longer, 4 feet wider and 2 feet deeper than any bulk freighter on the lakes, being 617 feet over all; keel, 597 feet; beam, 64 feet, and 33 feet deep. It will be noted that her radical departure is in her beam, which is 6 feet greater than the usual 600-foot type of lake steamer. She will not be able to avail herself of her full carrying capacity until the third lock now under construction at the Sault is finished, as she cannot pass through the Canadian lock at all and cannot avail herself of her full draught in passing through the Poe lock. Mr. Snyder, therefore, in building this steamer is in one sense of the word a pioneer. He has his eye on the future.

Col. James M. Schoonmaker, after whom this steamer is named, is the vice president of the New York Central lines, and it is related that he was responsible for the unusual beam of the vessel. He began his commercial life in connection with the river service of the New York Central lines and had long experience in shallow water navigation. In passing through the Sault on one of the big freighters he pointed out that the length was out of proportion to beam and that the steamers would be far more manageable if their beam could be increased. Every navigator, of course, recognizes this, but no owner had the courage to build a ship of greater beam than existing lock accommodations would permit.

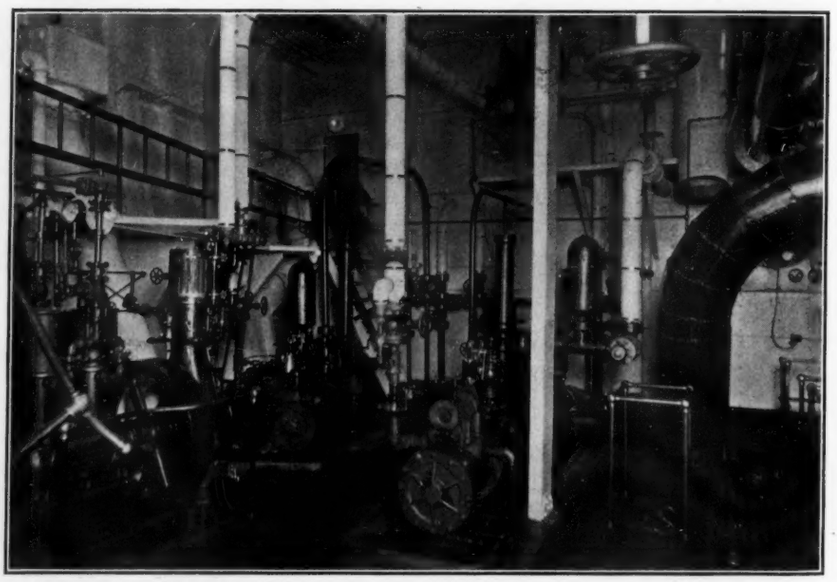
Location of Side Tanks

Aside from her dimensions, the Schoonmaker does not depart in any radical particular from the ordinary design of vessels of her class except that her side tanks are well set out from her skin in order to confine the cargo easily within the sphere of the self-filling bucket. The side tanks are 5 feet wide at the main deck and 12 feet wide at the tank top, so that it can be seen that her cargo is quite accessible as in a steamer of ordinary beam.

Water ballast is carried in the side tanks as well as in the water bottom, which is 6 feet deep, making a total water ballast capacity of 8,000 tons. Her cargo hold is divided into three compartments. In construction she is unusually staunch, having two extra longitudinal girders on the turn of the bilge in the water bottom. Moreover, her deck beams run fore and aft and are 13 inches deep, 4½ inches flange and ⅞ inch thick. All frames are joggled, eliminating liners back of shell plating. Her screen bulkheads are built on the box girder system. Her hatches, 35 in number, are 54 feet wide and 9 feet fore and aft. The hatch covers, which are of the steel telescopic kind fitted with Mulholland fasteners, are operated by wire cables running through portable tripods on deck and fixed cleats in the butt strap, power being supplied by the deck engines.

Propelling Machinery

The propelling machinery consists of a quadruple-expansion engine, 23, 33¼, 48 and 69-inch cylinder diameters by 42-inch stroke, the estimated horsepower being 2,600. The high-pressure cylinder is placed forward and the first intermediate aft; the low pressure cylinder adjoins the high pressure with the second intermediate installed aft of the low pressure. The high and intermediate cylinders are fitted with piston valves and the low pressure cylinder with a triple-ported slide valve. The high pressure and first intermediate pressure pistons have deep removable followers and the second intermediate and low pressure pistons have the Allen packing rings. All valves are operated with Stevenson link motion, the low pres-



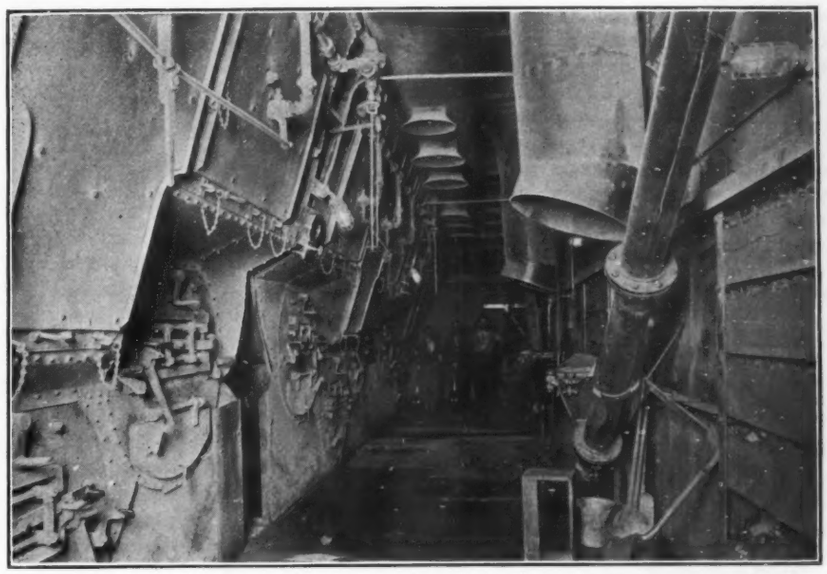
PORT SIDE OF ENGINE ROOM OF THE SCHOONMAKER AT WORKING DECK, SHOWING MAIN FEED AND FIRE PUMPS AND REFRIGERATING MACHINERY

sure and second intermediate being operated by a single rocker arm. Metallic packing of the United States make is fitted on all valve stems and piston rods. The air pump is worked from the low pressure cylinder crosshead. All valves are of ample area and are accessible for quick overhauling. The piston rods are 5½ inches in diameter, fitted into annealed steel crossheads having brass shoes for go ahead and backing. The crank shaft is of the built-up type with cast steel arms shrunk on. The thrust bearing is braced to the bed plate and has eight driving collars, giving a pressure per square inch of 40 pounds average working pressure. The outboard shaft is 12 inches in diameter enlarged in the stern bearing to 13½ inches. The propeller is of the sectional type, 15 feet, 9 inches in diameter with a circumferential pitch of 13 feet, 9 inches and a developed area of 92 square feet.

Water Ballast Pumps

To handle the enormous water ballast capacity of the ship, two 18-inch centrifugal pumps of the Kingsford type are provided, direct-connected to two 12 x 10 Kingsford enclosed double engines built by the Kingsford Foundry & Machine Co., Oswego, N. Y., and two Warren reciprocating pumps, 12 x 16 x 18, are in the lower engine room, conveniently located to the ballast header and so arranged as to pump in and out of the side tanks and water bottom, connected complete to each compartment by separate suction and filling pipes, 9 inches in diameter. The compartments can be filled or emptied separately or altogether by either or both pumps.

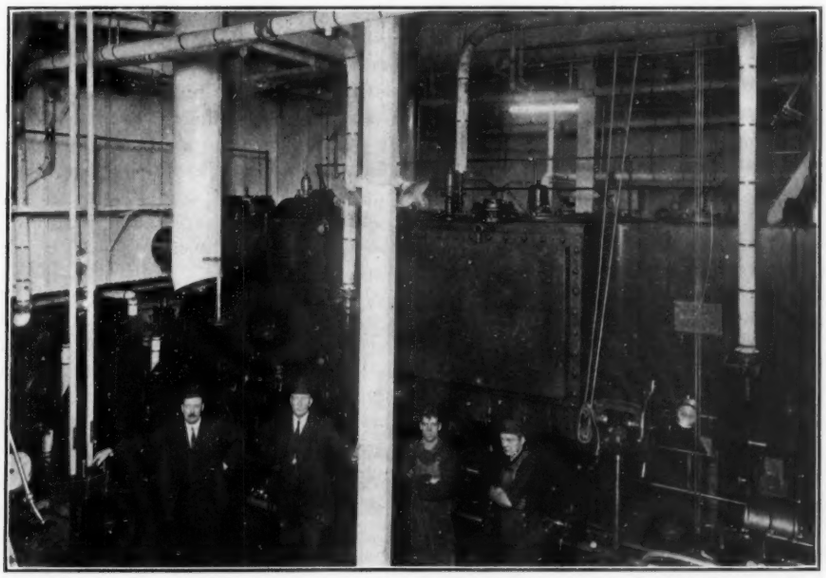
Steam is supplied from three Scotch boilers, 14 feet, 9 inches in diameter by 12 feet, 2 inches long, each boiler containing three 44-inch corrugated furnaces and allowed 220 pounds pressure.



STOKEHOLD OF THE SCHOONMAKER

The forced draft equipment, supplied by the American Blower Co., Detroit, consists of a top vertical discharge Sirocco fan driven by a 7 x 7 vertical self-oiling steam engine, direct-connected. The boilers are also equipped with front-end soot blowers which were recently put on the market by the Diamond Power Specialty Co., Detroit.

The steering gear is in duplicate with two wheel stands in the pilot house forward, with transmission gear of Akers type on each side of the steamer leading aft to two 9 x 9 Hyde steering engines located on the fantail and connected direct to a cast steel quadrant on the rudder stock.



STARBOARD VIEW OF ENGINE ROOM OF SCHOONMAKER AT WORKING DECK

To handle the mooring cables six Hyde engines are installed, four on deck, one aft of cabin and one in the windlass room forward. There is one Hyde windlass aft on fantail for handling a 3,500-pound anchor and one Hyde windlass forward for handling two 4,000-pound anchors.

Miscellaneous Equipment

A feed pump, 14 x 8 x 18; fire pump, 12 x 6 x 14, and two duplex pumps, 6 x 4 x 6 for safety purposes, are of Warren make, manufactured by the Warren Pump Co. The sanitary system of the Schoonmaker is the most complete on the lakes, the tanks for this purpose holding 50 tons of water. The refrigerating plant consists of one 2½-ton ice machine in the dunnage room forward for the passengers' quarters and one 3½-ton ice machine aft for the crew's stores. These machines were supplied by the Phoenix Ice Machine Co., Cleveland. The electrical equipment consists of two 15-kilowatt and one 10-kilowatt direct-connected Crocker-Wheeler generator driven by American Blower Co. engines, generating light for 700, 16-candlepower incandescent lamps. There are separate circuits for different parts of the ship. The spar deck is lighted by 24-candlepower lamps carried on poles amidships between hatches. The hold is lighted by two 32-candlepower lamps at each hatch.

Safety Equipment

There does not appear to be an auxiliary making for safety and convenience lacking in this ship. For instance, there is an electric helm indicator made by the Electric Dynamic Co., Bayonne, N. J., in the

wheel house operated by a rheostat connected to the rudder stock showing the officer in charge the position of the rudder at all times; there is in the wheel-house also a McNab indicator, a simple little device showing whether the engine is going forward or astern, in addition to the usual engine telegraph of great lakes type. There is an electric whistle device installed by the Signal & Control Co., New York, to sound signals as they are required, as well as blow them automatically during thick weather; and an emergency alarm manufactured by the Schwarze Electric Co., Adrian, Mich., which can be sounded from the pilot house to all departments of the vessel, should occasion require; a telephone service, consisting of independent lines from the pilot house to the engine room and from the captain's and passengers' quarters to the galley. There is a Schuette recording compass in the captain's quarters, providing an infallible record of everything that occurs in the wheel house at all hours. A wireless telegraph outfit has been installed by the United States Wireless Telegraph Co., and altogether the Schoonmaker would appear to have aboard everything that human ingenuity has so far devised to make navigation safe.

Passenger Quarters

The feature which will strike the layman of greatest interest in the Schoonmaker are the passenger quarters, so-called. Of course, they are not really passengers, but rather guests of the management. Since Mr. Snyder entered the lake trade he has spared no expense in providing for the entertainment and comfort of his guests, and in this respect the Schoonmaker marks a distinct advance over his other vessels, notable as they are for their decorative schemes and provision for creature comforts. On the Schoonmaker the entire deckhouse forward is given over to the guests. All the sleeping quarters for the passengers are on the spar deck situated on both sides of a wide hall leading directly into a grill room which extends the full width of the vessel and is crowded right up almost into the eyes of the ship. The effect as one enters is quite impressive, produced not only by the hall itself, with its ceiling lights, chairs, settees and davenports in fumed oak and Spanish leather, but with the vista which it affords of the grill room with its tile flooring, tile mantel, built-in sideboards, and electric fireplace. There are eight staterooms in all, single and *en suite*, finished in white enamel, the furniture being in mahogany with the exception of the beds, which are of brass. Each stateroom is provided with private bath and shower.

Sanitary Features

The sanitary features are, in fact, worthy of special mention, as they are the most elaborate that it is possible to build. The bath tubs are of the built-in type of great beauty of workmanship, and all plumbing is enclosed. The showers, with Niedicken mixture, were installed by the Hoffmann & Billings Mfg. Co., Milwaukee, Wis.

As stated, the grill room is crowded forward, making it possible for it to be lighted by a dome skylight which pierces the forecastle deck, the tone of the light being in harmony with the decorative scheme.

A stairway leads from the port side of the corridor to a small hall on the forecastle deck from which the observation room is approached. In keeping with the general scheme, the observation room is in fumed oak with Spanish leather and is equipped with writing tables, chairs and a built-in settee of splendid proportions amidships of the after side of the room. A feature of the room is a Victrola finished in wood to harmonize with the furniture.

The owner's quarters are on the port side in rear of the observation room and consist of one bed room and a bath room, with white tile flooring and a shower walled in marble, but no tub. The captain's quarters are on the starboard side aft of the observation room. A stairway leads off the captain's room to a smoking room or lounge, which is superimposed upon the observation room. This might be called the passengers' pilot house as it occupies the space usually employed for the enclosed pilot house on a modern freighter. Superimposed upon the lounge is the enclosed pilot house with outside railing and compass.

All cooking for the grill room forward is by electricity, the galley being on the main deck beneath the passengers' quarters and served by a dumb waiter. The electric stove was supplied by the Thermo Electric Co., Cleveland, and the steam tables by Weber & Co., Detroit. The stores are cooled by refrigeration, the ice machine being located in the dunnage room immediately forward of the galley. In this system coils of extra strong pipe are placed in the boxes and liquid anhydrous ammonia evaporated within them at a very low temperature, the ammonia in evaporating taking up the heat. Brine tanks of ample capacity are provided to maintain an equality of temperature when the plant is not running. The system also provides for making ice for table use.

Unusual thought has been expended upon the design of the crew's quarters. The first and second mate are housed on the forecastle deck aft of the owner's quarters, with a joint shower. The forward crew are housed on the main deck directly underneath the passengers' quarters and are supplied with all modern conveniences. The after crew, including the deck hands, are all provided with ample quarters on the spar deck aft, each room being provided with an electric fan. In fact, every room in the boat has a fan in it. The sanitary arrangements aft are as complete as they are forward, there being showers and baths in each department with private bath for the chief and first and second engineers. A drying room is also provided over the boilers where wet garments may be dried in a few minutes.

The after end of the deck house aft is given over to the private dining room for passengers and for the crew's dining room, the private dining room being on the starboard side and the crew's dining room on the port side. The private dining room is decorated in fumed oak and the crew's dining room in light oak, and it is a mere question of taste as to which is more attractive.

Schoonmaker Easily Handled

Capt. Thomas H. Sanders, who brought out the Schoonmaker, says that she is the easiest vessel in a seaway that he has ever sailed, being unusually responsive and manageable, due undoubtedly to her greater beam.

On her maiden trip she took 12,650 tons of coal from Toledo to Sheboygan. Her maiden cargo of ore consisted of 10,799 tons carried from Duluth to Ashtabula. When stages of water favor she can probably carry 14,000 gross tons on the Lake Erie run. On the run from Escanaba to South Chicago, where water is ample, she could probably carry 15,000 gross tons.

T. P. Kelly & Co., New York City, manufacturers of foundry facings and supplies, have received orders from the following concerns covering their entire requirements for heavy, light and other facings for 1912: Detroit Stove Works, Peninsular Stove Co. and the Michigan Stove Works, Detroit, and the Cribben & Sexton Stove Co., Chicago.

Prosperity Reigns in the Markets of Great Britain

Remarkable Revival of Demand for Bar Iron—Immense Volume of Railway Orders—The Brussels Conference

By J Horton

THE close of 1911 finds every branch of the British iron and steel trade active and flourishing with record production in some departments. Some such experience was anticipated at the beginning of the year, but the intermediate dullness of the spring came as a disagreeable surprise, while pig iron, which began the year at high figures, experienced a bad slump, from which it has not yet completely recovered. The most active branch throughout has been that of armaments, the great British works having benefited more than anybody from the great international scramble for naval supremacy. The three principal firms devoted to iron-clad building have two years' work on the books, even if they do not book another order. But several large contracts are expected from several nations which come to Great Britain for their naval equipment.

It is remarkable that the fluctuations of pig iron have not been shared by finished material, the steadiness which was such a feature in 1910 being once more conspicuous. This applies to both iron and steel. In regard to iron, actual selling prices are constantly recorded under the sliding scale arrangements of the Midland Iron and Steel Wages Board. The records for the present year are as follows: Early in January the selling figures for November and December were issued, showing an average net price of £6 7s 10d. For January and February this increased to £6 9s 2d. For March and April, £6 9s 7d, May and June £6 9s 4d, July and August £6 8s 11d, September and October £6 10s 4d.

Growth of Ship Building

The same uniformity has been manifest in connection with the Northern Iron and Steel Wages Board. For November and December, 1910, the average selling price was £6 7s 1d, January and February £6 6s 10d, March and April £6 6s 7d, May and June £6 5s 6d, July and August £6 6s 5d, and September and October £6 5s 3d. The last-named figures came as a surprise because the material decrease in price was concurrent with the large advance in output and a period of extraordinary activity at all the works. This is a feature quite peculiar to modern trade, and the usual comment made thereon is that increase of capacity continues practically parallel to demand, however great this may be. From the consumer's point of view, especially among ship builders, who take enormous quantities of material from the northern mills, this steadiness is a matter for congratulation, and is believed to have much to do with the tremendous growth in ship building which has been a conspicuous element in the trade revival. The same steadiness has been manifest in wages. In the north of England, the wages reduction of 2½ per cent which took effect on Nov. 28, 1910, has never since been recovered. Under the Midland Board there was an advance of 2½ per cent realized in February last, and based upon the December return, and at the figure of 8s 9d per ton, puddlers' wages have still remained. There was a general expectation that the November return would give an advance, and there is some disappointment in labor circles over its failure to do so. It will be seen that for six months, namely from January to June, there was a variation of only 2d in the selling price.

The above returns in both districts apply to four separate classifications of finished material. In the north of England the description is rails, plates, bars and angles, and in the Midlands bars, angles and tees, plates and sheets, hoop strip and miscellaneous.

It is impossible that this uniformity of selling prices can further continue in the official records, because advances are known to be of a very substantial character in leading branches of the finished iron trade. Unmarked bars, which began the year at £6 2s 6d, are selling readily at £6 15s, an advance which, after a long period of depressed prices, is regarded with astonishment. The most conspicuous feature of the iron trade has been the revival of unmarked bars, Many years ago, South Staffordshire staked its reputation for the high quality of Staffordshire iron mainly on its bars, but, latterly, they have been nearly a drug in the market, and quite a number of old-established mills had to close. The end of the year finds several mills restarted, after long periods of idleness, with consumers offering substantial premiums to get deliveries. The revival is partly due to the gradually formed conviction that steel, in spite of its many merits, is a short-lived material, being extremely susceptble to corrosion. This view, it will be remembered, was emphasized with great force by American visitors to the Iron and Steel Institute meeting in London a few years ago, and, since then, plenty of evidence to the same effect has been forthcoming. Nevertheless, there was a mild sensation when leading railway companies specified for iron underframes for very large wagon orders given out in the early autumn. This is the most acceptable plum which Staffordshire ironmasters have had for many a long year, and they are looking forward to good times for the next year or two. At the same time, the experience of last spring furnishes a warning against over-confidence, as business fell off very considerably, entirely failing to realize the optimistic expectations indulged in in January. The gloom of a very dismal spring was intensified by the failure of Tupper & Co., in March last, with total liabilities approximating to £100,000. The failure was attributed to financial difficulties, and was precipitated by the action of the bank. The general soundness of the iron trade was manifest from the fact that, so far as is known, no single firm came to grief through the Tupper collapse. The most important of the mills connected with that establishment have since resumed operations under other proprietorship and management.

Demand for Puddled Bars

Among the problems worrying the trade at the close of the year is that of the future supply of puddled bars. So many puddling furnaces have been destroyed, through the general preference for steel, that the sources of supply are notoriously deficient, and fancy prices have been obtained for puddled bars by certain firms which

so far maintain their faith in the longevity of iron as to keep their puddling furnaces in existence. That faith during the past few months has won a very handsome reward in their ability to sell every pound of puddled bars they have been able to produce. Even if the furnaces were available, the labor problem would be still more formidable, as puddlers are difficult to find, the race having almost died out, while recruits are not forthcoming. If the old-fashioned wrought iron of South Staffordshire has really obtained a new lease of life, the great desideratum, likely soon to become urgent, is the one which occupied the attention of experts in the eighties, namely that of finding a really efficient and reliable device for mechanical puddling. The general feeling seems to be that that old problem is not yet within measurable distance of solution.

During the whole of the year, marked bars have continued at £8 per ton, thus establishing a new record of uniformity, as this was the selling figure also during the whole of last year, although during that time there has been a very considerable fluctuation in common iron.

Low Sheet Prices

Without going into details of other finished iron, it may be said that there has been a good out-turn in all departments. The surprise has been the low figure at which galvanized sheets have been maintained during the whole of the year. Although there has been an enormous output, the price is substantially what it was a year ago. No attempt has been made to organize any price agreement, and the enormous addition to capacity, brought about by the establishment of new mills, especially in South Wales, has prevented any rise, notwithstanding abnormal selling prices of spelter. American competition in this line is much more seriously regarded than it used to be. It is remarkable that very little progress has been made in the use of the new patent roofings, invented some years ago as a substitute for corrugated sheets, and by means of which whole structures can be built, merely by fitting the sheets together. Several British railway stations have been built with this material, and the colonies have taken large quantities; but the much higher price is, on the whole, prohibitive, and it is likely that one of the developments of the new year will be the establishment of a large company for the production of this material completely from the raw material. In the early part of the year, galvanized holloware had a very quiet time; but this branch of the trade has had a gratifying revival both in output and price, and the year is ending with heavy accumulations of orders on the books.

Conditions in Pig Iron

In regard to pig iron, the experience has been in many respects different from that of the finished department. The early expectations of high prices entirely failed to materialize. In January, No. 3 iron at Cleveland was 50s 3d, and many people bought heavily at that figure, expecting it to be maintained; but, within three months, the prices had fallen to 47s, and the decline steadily continued, accompanied also by large increases of stock, which eventually compelled the northern smelters to blow out several furnaces. By October, prices had decreased to about 46s; but by this time a change had taken place in the stocks, and since then there has been a steady decrease. It was not until the middle of November that a real advance in price set in, and the close of the year finds a steady rise in the price of iron and an equally satisfactory diminution of stocks. As this course of prices has been substantially followed in the Midlands, the Black Country bar makers derived an enormous advantage from the concurrence of cheap pig iron with steadily improving prices of finished material and unchanged wages. This was a most unusual experience, exactly opposite to the conditions prevailing for some years past. The entire absence of American pig iron buyers, remarked a year ago, is still a noteworthy feature, and less material also has gone to the Continent. It is believed this has had much to do with the comparative weakness of pig iron; but the absence of speculation and the dependence on the home market has given a solidarity to the trade, undoubtedly of great value to the British user of pig iron. By the beginning of December Connals' stores, which commenced the year with 370,000 tons, and increased subsequently to about 600,000, had receded to 550,000 tons, and this decline is still in progress. But it is noteworthy that prices have not recovered entirely from the bad slump of the spring, the selling price being about 48s, or nearly half a crown lower than they were a year ago, notwithstanding the fact that at that time prices were increasing.

The experience of the steel trade makes a curious history for the year. The consumption of steel has gone on by leaps and bounds. In regard to finished material, the great addition to buyers has been a huge volume of railway orders. During 1910, the railways scarcely took anything, making full use of their rolling stock, on the economical lines which various amalgamations had enabled them to do. It is now clear that this policy was carried a little too far, although this is nothing new in experience of railway buying. The general trade revival caused a great demand for rolling stock, but the desperate inadequacy was not clearly revealed until the railway strike of August. It then became clear that the companies had been working entirely without any margin of vehicles, and, since that time, they have never been able to overtake the congestion. At the present time, there is hardly an ironworks or colliery but is suffering inconvenience. Ships are leaving without their proper cargoes, many collieries have been brought to a standstill through want of trucks, and enormous inconvenience has resulted generally. The railways are now tumbling over each other in placing orders for cars and rails, and everybody who has wagons to sell can realize very comfortable prices for his vehicles. Practically all the Sheffield works are producing at their utmost capacity, and in many cases making overtime. An extremely busy period is in prospect for the coming year.

Steady Price of Steel

The ship building industry has also been a huge consumer of steel, the Clyde returns for some months establishing new records. This has been very much assisted by the steady price of steel, a circumstance more remarkable from the great activity at the steel works, and the gradual withdrawal of foreign competition. For nearly every description of finished steel, prices are just what they were in January last. This uniformity has prevailed in spite of great advances on the Continent, and considerable fluctuation in America. It has greatly assisted ship builders and structural engineers to make contracts. It has undoubtedly assisted also in giving the British ship builders a tremendous hold on the world's markets. During the previous boom, the rise of about a pound per ton in ship plates greatly shortened the period of the boom, as far as shipping was concerned. The price uniformity is claimed by steel makers themselves to be entirely due to their organized

control of the trade and the steady purpose they had in view rather to hold the buyers in their own hands and exclude foreign makers than to make the last shilling out of their products.

The unfinished steel trade has had a rare experience, in the constant reduction of imported steel. America's contributions have become quite negligible, while Germany and Belgium have steadily decreased their supplies, and have now nothing to offer during the first few months of the year. An immense quantity of business has therefore been diverted to British mills, several of which are being enlarged to meet the demand, while large works are being erected in Middlesbrough for the supply of British needs. Experienced merchants believe that a feature of the new year will be a considerable resumption of steel buying from America, and negotiations are in progress with that view. The fact that American prices are not rising concurrently with those of Europe is regarded by British steel makers as an important element, with great possibility in the way of competition for the new year.

The International Conference

Outside market experiences, several matters call for passing notice, and undoubtedly the year will be regarded as memorable on several accounts. In the steel trade, the International Conference of July would alone suffice to give distinction to the year 1911. As a social function, the gatherings, both in London and Brussels, are looked upon in this country with unalloyed pleasure. There has never been such fraternal hobnobbing between the world's steel men. As a representation of steel trade capital, the meeting has never been equalled, and the gathering was splendidly successful for the good feeling evoked. But British steelmakers are still speculating as to what the practical outcome will be. Undoubtedly, the personality of Judge Gary impressed itself very strongly upon the European delegates, and especially upon those of Great Britain, and while the disposition on this side is to look to America for practical initiative, there is still the fullest confidence that Judge Gary will make the most of such opportunities as are afforded for international co-operation by the association established in July last. At the same time it is recognized that recent proceedings in America, especially in the government action against the Steel Corporation, may prevent, or at least delay, the materialization of Judge Gary's projects. There is an inclination in Great Britain to regard the present arrest of continental supplies as being in some way associated with the international conference.

Restriction and Taxation

The complaint made a year ago of undue interference by government in the way of restriction and taxation is still more commonly made now. The eight-hour mine act has added to the cost of coal production. That addition has in some cases, according to experts, varied from £5,000 to £20,000, and some collieries have been stopped. It is generally agreed that the new insurance bill, now passing through parliament, will involve very serious additions to the burdens of capital, against which the British ironmaster never misses an opportunity to make his protest; but, apparently, without the slightest effect in staving off the objectionable legislation.

The close of the year finds the steel trade in a state of lively controversy over the rebate proposals, under which makers offer 5s per ton to their customers, on the understanding that they buy only from British makers instead of from foreigners. There is every prospect of its success, although some modifications may have to be made to meet the objections of the merchants who frankly dislike the scheme.

One of the results of the labor unrest which culminated in the railway strike in August was the abandonment of the Iron and Steel Institute meeting projected at Turin, although elaborate arrangements have been made for that meeting. Right to the end of the year, most of the British steelworks are experiencing the evil effects of the railway strike in congested deliveries, shipment delays, etc. In the Midland district, the strike undoubtedly gave an impetus to the movement for the development of a ship canal connecting Birmingham and the district with the sea, somewhat in the same way that Manchester is connected.

Great Use of Electricity

The year undoubtedly has seen considerable mechanical and industrial progress, electricity having been extensively adopted for mill driving and other subsidiary purposes, especially for lighting and auxiliary machinery.

For several months in the year, efforts were made to unite the various tube manufacturers of the kingdom for the revival of the formerly existing amalgamation; but the effort has been unsuccessful so far, and its prospects are not considered hopeful. In Birmingham, great importance is attached to the success of the non-ferrous metal manufacturers in raising the price of copper, bronze, and similar metals by means of an association. This business has been quite unprofitable for some years past. There is much elation over the success, which, while it has made business profitable, has apparently not lost the trade a single customer.

Undoubtedly the most serious element throughout the year has been the labor unrest, which has kept business in a state of ferment for many months, and has kept manufacturers in constant dread of strikes. At the time of writing, Dec. 4, it is still uncertain whether the railways may not once more be entirely stopped during the Christmas season; but there are hopes that, by means of the intervention of the board of trade, and the very generous concessions to workmen made by the railway companies, this appalling disaster may be averted. At the same time, the attitude of the government in its pro-labor sympathies on the one hand, and what is called its employer-phobia on the other, has alienated a good many of its supporters.

Outlook for 1912

In spite of all disadvantages, of labor unrest at home and wars and rumors of wars abroad, business maintains a large volume and a swinging pace; and unless the unexpected happens, everybody is expecting for 1912 one of the finest years in the history of the iron and steel trade.

The Smoke Nuisance

In a discussion on the smokeless combustion of bituminous coal at a recent meeting of the Engineers' Society of Western Pennsylvania, W. E. Snyder, mechanical engineer of the American Steel & Wire Co., Pittsburgh, cited an instance in which that concern overcame the smoke nuisance at one of its plants in Cleveland. The original installation at these works consisted of 28 return tubular boilers, each 66 inches in diameter and 16 feet long. These were all hand-fired, with Pennsylvania or Ohio run-of-mine coal. Smoke was always produced in great volume, as evidenced by the reports of the smoke inspectors. It finally became advisable to replace the boilers because of deterioration; it was necessary also to provide for a higher steam pressure. The new equipment consisted of 16 300-horsepower Stirling boilers which were provided with chain grates.

Careful attention was given to all the details of the setting of the grates, boilers, flues and stacks, with the idea of eliminating smoke, and, at the same time, operating the boilers efficiently from a fuel consumption standpoint. The results were that the plant has now operated for four or five years with practically no smoke at any time.

Another method investigated for the prevention of smoke was that of the installation of dust fuel, that is, pulverizing the coal very finely before it is blown into the furnace. The economy of fuel and the conditions as to smoke prevention proved to be satisfactory. The heat generated in the furnace, however, was so intense that it was impracticable to obtain any furnace lining that would stand it. In several cases, too, a large part of the ash of the fuel which had been reduced to dust in the pulverizing process was blown from the stack and distributed over the entire neighborhood, thus proving to be a worse nuisance than smoke.

Smoke Prevention

Mr. Snyder claims that there is nothing mysterious or difficult in the theoretical principles which govern the prevention of smoke. It is simply necessary to burn completely all the combustibles in the gaseous products of oxidation before these gases reach the comparatively cooler heating surface of the boiler. Since combustion is the combination of oxygen with the combustible elements of the fuel it is necessary to make the conditions such that this combination will be completely carried out before the process comes to an end. As this combination takes place only at high temperatures, it is necessary that the furnace should be kept hot; also sufficient air must be present and properly distributed. The combustion chamber should be lined with brickwork on all sides except, of course, the direction in which the gases are moving. In order that all the particles of combustible matter may be oxidized, time is required. This time may be gained by making the section of the combustion chamber large, so as to reduce the velocity of the gases, and also by making the combustion chamber long, so that the combustible particles will all find their respective oxygen molecules before the temperature is reduced. Sometimes, where it is not possible to obtain the desirable length, various other devices, such as wing walls, arches, etc., are adopted with the idea both of facilitating the mixture of the combustible matter and the oxygen, and of increasing the heat temperature.

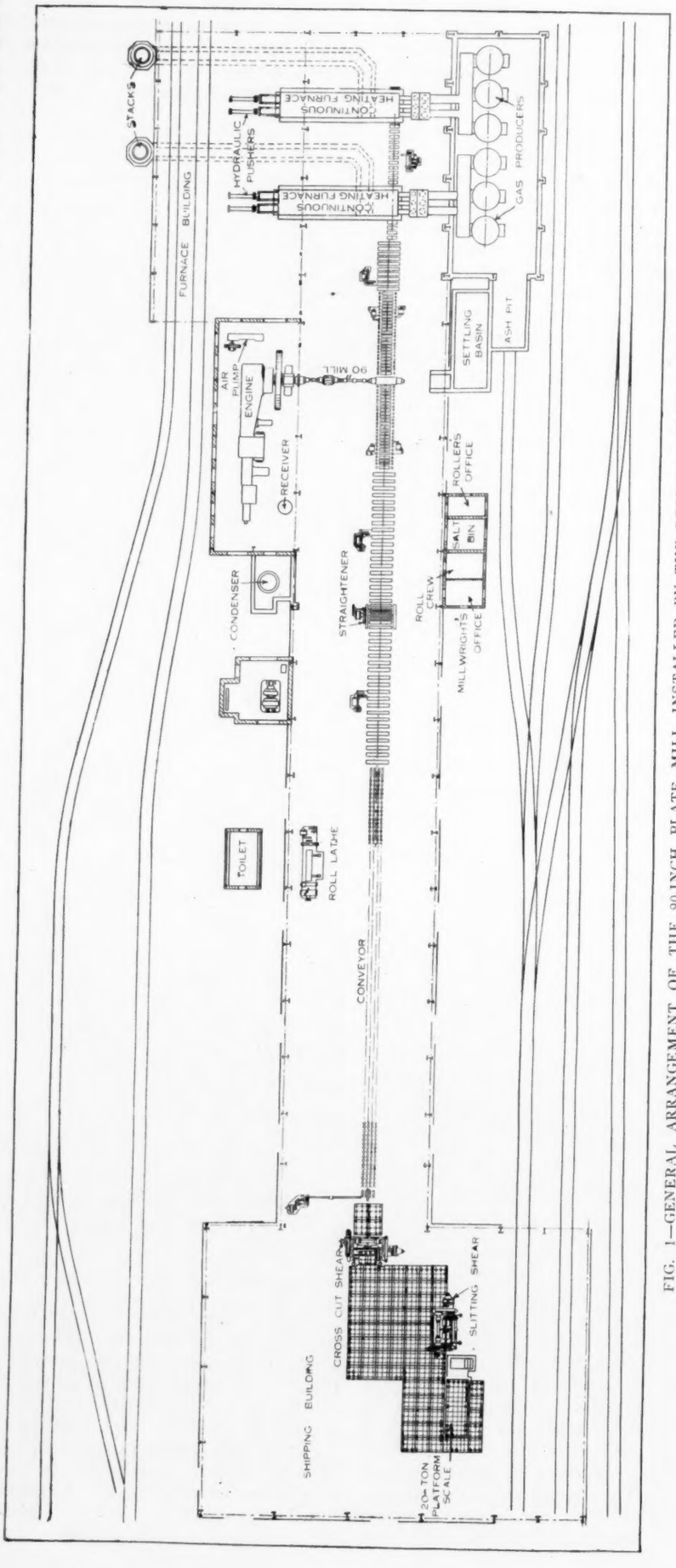
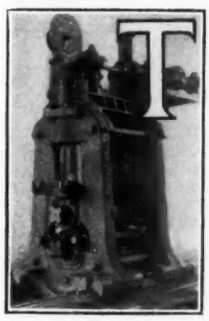


FIG. 1—GENERAL ARRANGEMENT OF THE 90-INCH PLATE MILL INSTALLED BY THE REPUBLIC IRON & STEEL CO.

A New Plate and Merchant Mill Installation

A Description of the Most Recent Increase in the Finishing Capacity of the Republic Iron & Steel Co.



THE STEEL and pig iron producing and finishing capacities of the Haselton plant of the Republic Iron & Steel Co., Youngstown, O., recently have been increased by the erection of a 500-ton blast furnace, eight 60-ton, open-hearth furnaces, blooming, continuous billet and sheet bar, 16-14-inch merchant and 90-inch plate mills. The open-hearth plant, blooming and continuous billet and sheet bar mills were described in THE IRON TRADE REVIEW, Aug. 17, 1911, and an article devoted to the blast furnace plant was published in these columns on Dec. 28.

The 32 x 90-inch plate mill was built primarily for the purpose of completing the company's facilities for manufacturing all of the skelp required for its new tube works. It also greatly increases the company's range of plate sizes for the market from skelp, 25 inches wide to plates, 84 inches wide. The mill is three-high and is driven by a 34-inch and 60 x 60-inch, horizontal tandem compound engine of approximately 2,500-horsepower capacity at 80 revolutions per minute. Views of the plate mill from the furnace and delivery sides, respectively, are shown in Figs. 2 and 3 and a plan showing its general arrangement is illustrated in Fig. 1.

Features of Mill and Tables

The mill and tables were designed and built by the United Engineering & Foundry Co., Pittsburgh, and embody a number of interesting features. The roll housings of the mill are cast steel, the rolls being 90 inches long, the top and bottom rolls being 32 inches in diameter and the middle roll, 22 inches in diameter. The top roll is counterbalanced by weights, the balance levers being carried on the housings and are connected to the balance rods by links which keep the rods in contact with circular segments on the levers, thus compelling the rods to move vertically and to prevent bending. Weight levers are carried in pillow blocks on the foundation outside of the scale pit and are connected to the balance levers by spindles which compensate for any irregularity in setting and are easily removable if it becomes necessary to dis-assemble the balance rig. The middle roll is raised by hydraulic cylinders on the side of the housings, which are connected to the roll by balance arms connected by rock shafts and levers for equalizing the lift.

The fillings for the top and middle rolls are held in place by cover plates on the outside of the housings. These plates, by loosening a few bolts, can be moved sidewise and can be left on the housings, while the fillings are removed to change the rolls or for rebabbitting. The screw-down is operated by a 37½-horsepower, Westinghouse mill type motor with slip gear and magnetic brake, through worms and wheels which are entirely enclosed and run in oil. The worms and wheels are right and left hand to equalize the thrust. The entire screw-down mechanism is carried on a steel casting, extending from housing to housing, which forms the bearings for the worms and wheels, and carries the motor. The entire screw-down mechanism can be removed by attaching crane chains to four eye-bolts. The screws are adjusted relative to each other for the alignment of rolls by means of a clutch on the end of the screw-down shaft, which can be disengaged, allowing one screw to be moved independent of the other. The indicator is of the drum type, carried on top of the screw, and indicates to one-thousandths of an inch of plate thickness. The intermediate and vibrating spindles are 10 feet long and are

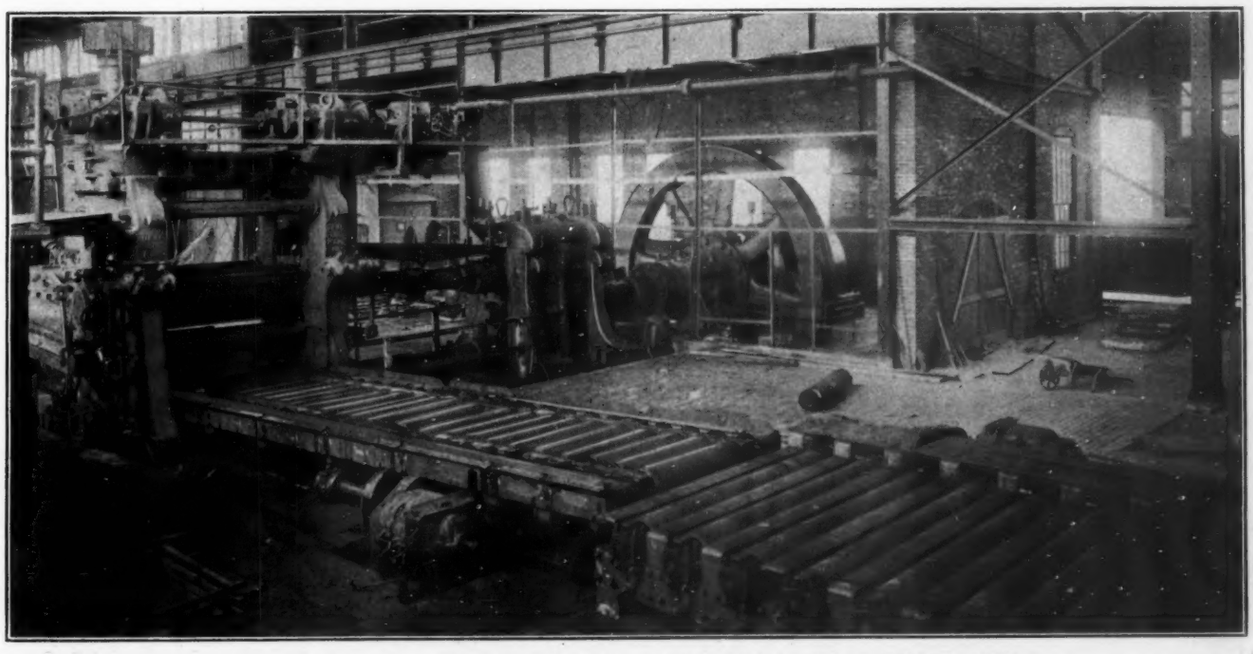


FIG. 2—A VIEW OF THE 90-INCH PLATE MILL FROM THE FURNACE SIDE

FIG. 3—DELIVERY END OF THE 90-INCH PLATE MILL

provided with spindle carriers of the usual design. The pinions are cast steel, the top and bottom pinions being 35 inches in diameter and the middle pinion, 22 inches in diameter by about 40-inch face. The engine shaft is connected to the middle pinion. The pinion housings are cast steel of the enclosed type, cast in two pieces and are connected by heavy flanges and bolts. The caps are cast steel and are cast together so as to completely cover the pinions. Oil tight doors are provided in the housings and in the caps for inspection.

The tilting tables are 28 feet long, center to center of end rollers, and have side shafts which drive the alternate rollers. The table rollers are 13 inches in diameter and 4 feet long with shafts cast-in, having discs of the same diameter as the rollers on the outside of the bearings. The table girders are of I-beam section, cast steel, with the seats for the roller bearing brasses cast-in. All bearing brackets and caps are cast steel.

Each table is operated by two 37½-horsepower, Westinghouse mill type motors, connected to the table through countershafts. These motors are arranged to run in series and are equalized by having one roller in each table geared to both line shafts. The table is pivoted on a segmental shoe, resting on a babbitted bearing in the pivot base, by which means an exceedingly large bearing surface is secured. This shoe also forms the separator for the table girders and provides means for carrying the motors which are located at the point of suspension and, consequently, have very slight motion. This arrangement has been found to be very efficient in reducing the cost of motor maintenance. The raising and lowering of the tables is accomplished by hydraulic cylinders operating

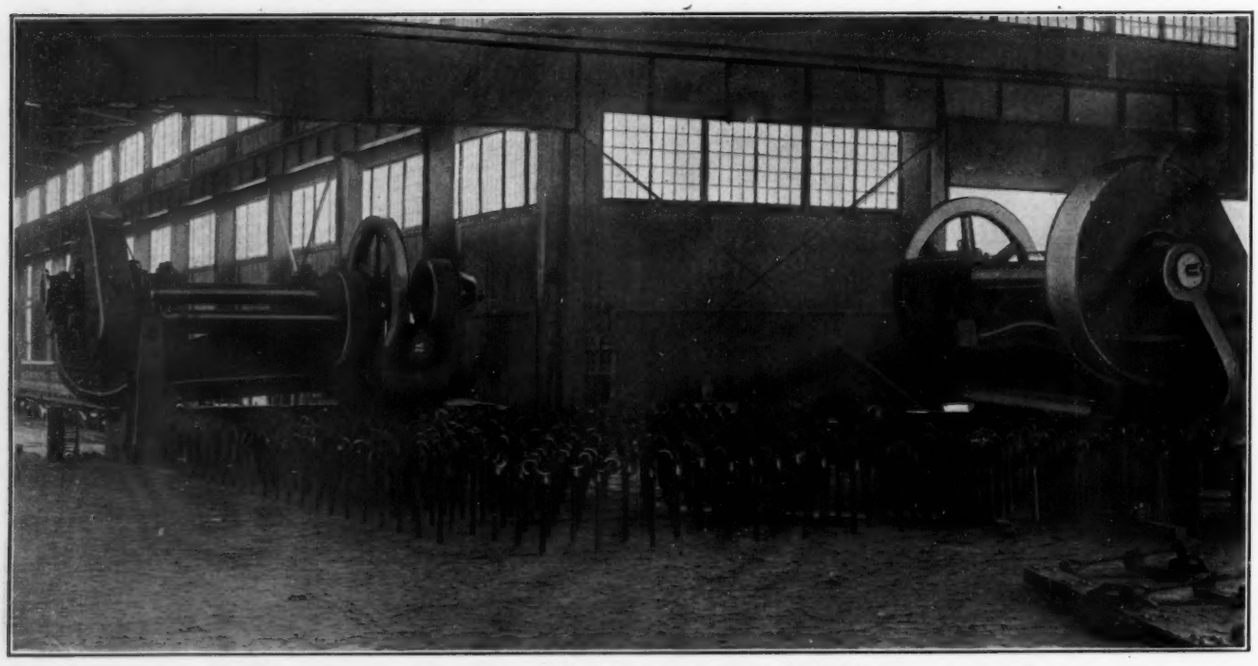


FIG. 4—THE TWO 110-INCH PLATE SHEARS

FIG. 5—VIEW OF THE 16-14-INCH MERCHANT MILL FROM THE PRODUCER PLATFORM

through levers with weight counterbalance. The lifting rig is made with large pins and links, designed to keep the bearing pressure low, thus reducing the wear and consequent cost of renewal. The struts connecting the lifting levers to the tables have cast iron balls at their upper ends, which work in babbitted seats in the table girders, thus taking care of any irregularity. These rods have provision for adjusting the height of the table. Care has been taken to make the cap bolts of ample size and they are arranged so that they are easily removable for loosening the brasses and to reduce to a minimum the difficulties of keeping them tight. Care also has been taken to provide gear covers that will not be shaken loose by the movement of the table.

Heating Furnaces

The slabs are heated in two gravity discharge heating furnaces, the charging ends of which are served by an overhead crane equipped with a magnet. Space has been reserved for an additional furnace of the same type or for two Siemens furnaces in case the demand upon the mill is such as to warrant the installation of the latter. Gas is furnished by three gas producers for each furnace. Two 110-inch plate shears, Fig. 4, are provided for the regular shearing equipment and a circle shear for cutting circular plates. The plate mill building is of steel construction and overhead cranes command all of the machinery.

The 16-14-inch merchant mill was built for the purpose of providing additional tonnage for the company's increasing demand for merchant shapes and is designed to roll rounds from 1 inch up to and including 3½

FIG. 6—THE FINISHING END OF THE MERCHANT MILL

inches in diameter and equivalent weights of ovals, squares, etc., flats up to 12 inches in width, angles up to 5 x 5 inches and I-beams, Channels, etc., of equivalent section. The general arrangement of this mill, built by the Morgan Construction Co., Worcester, Mass., is shown in Fig. 5, which is a view from the producer platform and Fig. 6 shows the finishing end.

The billets are heated in two gravity discharge heating furnaces and space has been reserved for an additional furnace should this become necessary. The charging ends of the furnaces are served by an electric, overhead traveling crane for handling the billets and slabs from the transfer cars directly to the furnaces. These furnaces, which are of the Morgan type, are 13 feet wide and are designed to take 6 x 6-inch by 12-foot billets and slabs of equivalent section.

The merchant mill consists of eight stands of 16-inch rolls in tandem, in which all of the larger sizes can be finished and delivered directly to the cooling bed, Fig. 7. Three stands of 14-inch rolls are also provided for rolling smaller sizes. The mill is so arranged that the material can be diverted to the 14-inch rolls after it passes through the sixth or seventh stand of 16-inch rolls, thereby permitting the changing of the finishing rolls of the 16-inch mill while rolling sizes which can be finished in the 14-inch mill.

The entire mill is driven by a 36-inch and 66 x 60-inch horizontal cross-compound Corliss engine with a speed range of 45 to 80 revolutions per minute. A double cooling bed has been installed with a total length of 160 feet, so arranged that a single row of the smaller sizes can be handled in lengths up to 160 feet or a double row of the larger sizes in lengths up to 80 feet.

The main building is 825 feet long and 115 feet span of building columns and contains two 15-ton electric, overhead traveling cranes, one of which is intended for general service and the other for loading material.

For both the plate mill and merchant mill engines, steam is provided by the main battery of boilers at the open-hearth plant. The tables, shears, straighteners, etc., in both mills are electrically-driven, power being supplied from the blast furnace plant.

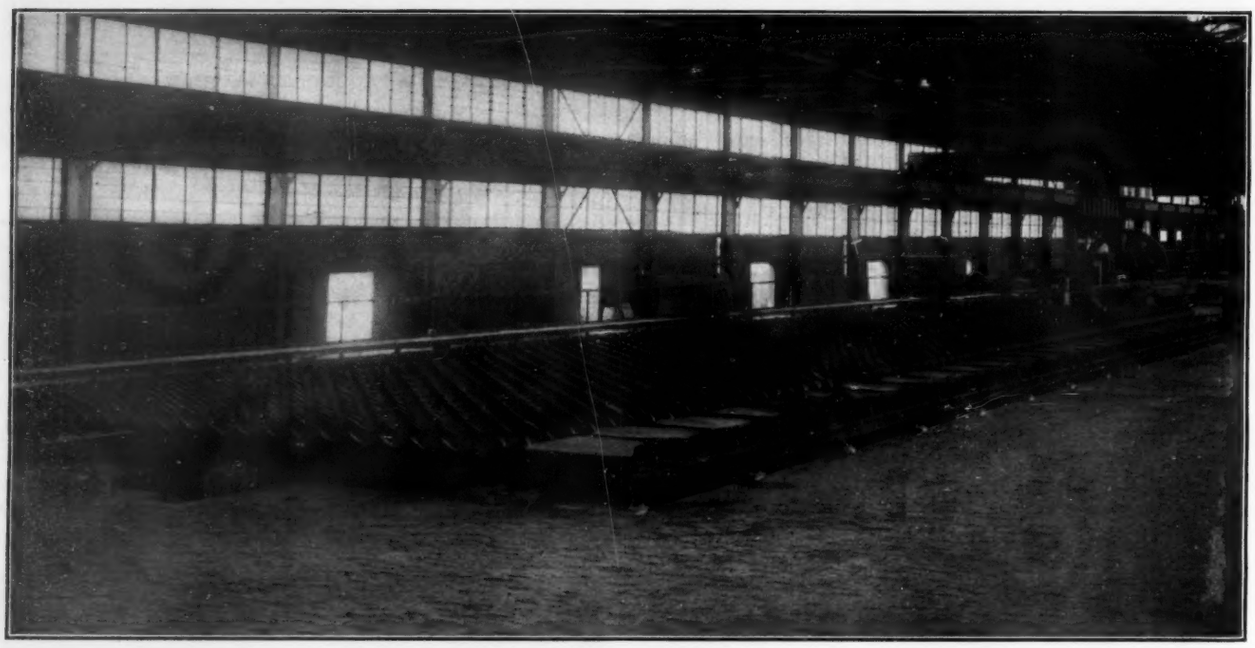


FIG. 7—THE MERCHANT MILL COOLING BED

Cost of Anthracite Coal

Anthracite coal was at one time an important factor in blast furnace practice, but for this purpose it has been almost entirely supplanted by coke made from bituminous coal, according to E. W. Parker, coal statistician of the United States geological survey, in an advance chapter from "Mineral resources for 1910," just issued. The principal future demand for anthracite will be restricted largely to domestic trade, for which the sizes known as furnace, egg, stove, chestnut, and pea are required.

The breaking-down of the lump coal, which was formerly a marketable product, for the preparation of the domestic sizes, results in an increased proportion of the small or undesirable sizes, all of which are sold at less than the cost of production. The proportion of these small sizes has increased from 23.1 per cent in 1890 to 41.6 per cent in 1910, while the proportion of sizes larger than pea coal, or what may be termed the profitable sizes, has decreased from 77 to 58.4 per cent. The price of anthracite coal at the mines in 1910 averaged $2.13 per long ton. All the profits on the mining operations must be obtained from the prepared domestic sizes, for the revenue obtained from the smaller sizes, which are sold largely in competition with bituminous coal for steaming purposes, serves only to reduce the cost of the domestic sizes. The conditions under which the anthracite mines are operated, says Mr. Parker, the greater depths to which the workings are carried, the consequent increased expense of mining, and the increasing cost of labor all contribute to make anthracite fuel more and more a luxury. No hope is held out to the consumer that anthracite will in the future be sold at lower prices than those which prevail today; on the other hand, there is every reason to believe that prices must advance in accordance with the increasing cost of production. It is only by reason of economical administration that prices are not higher than they are.

Improvement in the West as the Year Closed

Moderately Active Market During Most of the Twelvemonth in Spite of Adverse Conditions—Many Disturbing Influences Removed

By H Cole Estep

IN THE spring of 1910, it became evident that the season of prosperity inaugurated during the previous fall and winter was premature and that the readjustment following the economic disturbances of 1907 had not run its course. Nevertheless, an effort was made by the iron and steel trade to stave off the inevitable, and throughout all of 1910 and early months of 1911, business was sought on a basis which has since proved to be untenable. The pig iron market alone during this period gave much heed to the pressure of conditions and submitted to a reduction in prices. Lower quotations on finished steel, rails, bars, plates, structurals, wire, sheets, etc., were firmly resisted and efforts, naturally somewhat unsuccessful, were made to maintain the market at the level established by the brief wave of business activity early in 1910. Thus the final period of readjustment and realignment was deferred until 1911, and the year recently closed was notable for its price reductions and its elimination of uncertainties. In these movements, the Chicago market participated to a large degree.

In spite of the adverse conditions briefly mentioned above, the volume of business in the west was moderately heavy throughout the entire year and this aided considerably in enlarging the meager manufacturing profits of the season.

Unsettled Problems

At the opening of the year, there were several unsettled questions of national importance which acted as a heavy drag on the iron and steel market as a whole. These included the controversy between the railways and the Interstate Commerce Commission over a proposed general advance in freight rates, the decision in the government's suit against the Standard Oil Co. and the American Tobacco Co., and the attitude of the administration on the trust question, with particular reference to its intentions with respect to the United States Steel Corporation. The freight rate controversy was disposed of toward the end of the first quarter, and although the petition of the roads was denied, leading railroad officials now concede that the decision was just and that it was fortunate they did not obtain the higher rates for which they clamored. With the prospect of a wholesale readjustment of railway freight charges removed, the iron trade, particularly in the west, where hauls are long, breathed a sigh of relief. In May followed the decision in the Oil and Tobacco cases, and the assurance given by the Supreme Court that business will be regulated without being destroyed caused a marked improvement in sentiment in the iron trade. Finally, on Oct. 26, the government filed its now famous action against the Steel Corporation, and although the move naturally had a depressing effect for a time, the further elimination of uncertainty, which it brought about, has been beneficial. Thus a number of important and perplexing problems have either been solved or are in process of solution and, as a result, the iron trade faces a much freer outlook than that which confronted it at the opening of the year.

Price Reductions

At the same time, prices have been radically lowered and at present appear to be more in conformity with actual economic conditions than they have been at any time for three years. The extent of the readjustment which has taken place during the past two years, and particularly during 1911, can only be appreciated by comparing the quotations today with those existing previously. From the high point in 1910 to the low point in 1911, local northern foundry pig iron declined $5 a ton. Southern iron in this market dropped $4.25 during the same period. Between Jan. 1 and Dec. 1, 1911, bar iron in the Chicago market was reduced practically $4 a ton; steel bars fell off over $7 a ton and plates and structurals over $6. Wire products, although advanced in the spring, suffered a net decline of $4. Scrap moved within more narrow limits, but declined from $1 to $3 per ton. While these price reductions are due largely to the operation of the law of supply and demand, and the economic necessity for a readjustment on a lower and consequently more stable basis, the failure of the policy of co-operation between manufacturers, which had been prominent during 1910 and the year previous, undoubtedly precipitated and accelerated the violent declines which characterized the markets during the year recently closed. How thoroughly the co-operative spirit for the time being has been subdued is indicated by the promptness with which the western markets broke away from the long established Pittsburgh basing point, the instant it became evident that there would be any competitive advantage in so doing.

Slight Improvement

The first two months of the year were characterized by an improvement in conditions which was more apparent than real, due to the particularly quiet period at the close of 1910. During this interval of inaction, some consumptive needs had accumulated, which resulted in moderate buying during February. Due to this ripple of activity, southern foundry iron, which had gone down to $10.75, Birmingham, in January, rebounded to the $11 basis, on which it remained until May. The climax of the buying movement in pig iron was reached toward the middle of February, when a Chicago pipe manufacturer purchased 25,000 tons of low grade irons. Pig iron continued firm through March in the face of a very slow demand, due to the fact that furnaces still had considerable tonnage to dispose of on high priced contracts and were, therefore, not so desperately in need of business as they became later.

Possibly in anticipation of a favorable decision in the freight rate case, the activity during the first quarter was aided slightly by railroad interests. Some fair bar orders were received from several western lines and a little car business was placed, including an order for 2,000 cars from the Missouri Pacific. Also during this period, the rail buying which had been deferred during the last quarter of 1910 took place, and the Illinois Steel Co. booked 100,000 tons of rail orders during February. Fabricating contracts were also fairly satisfactory during the latter part of January and February. In the Chicago market, contracts involving 31,000 tons of plain material were placed during the week of Jan. 26, including 12,000 tons for the Insurance Exchange building, Chicago, let to the Brown-Ketcham Iron Works. During the first week in February, fabricating contracts totalling 21,000 tons were booked and plate mills at this time were operating about 70 per cent capacity. The unstable nature of the situation, however, was indicated by the extremely spirited

competition for business and by the low fabricating prices which were necessary to bring out the tonnages mentioned above.

Although sheet mills in the Chicago territory were operating at only half capacity at the opening of the year, this was increased to 90 per cent toward the close of the first quarter, at the expense, however, of prices. The demand for wire was also active early in the year, so much so that the makers felt justified in advancing prices $1 a ton in March, which brought them up to a point only $1 under the figures prevailing in January, 1910. This shows clearly the vigorous efforts which were made to maintain quotations at or near the high level prevailing during the business spurt which followed the panic of 1907.

As the second quarter opened, the adverse decision in the railway freight rate case was handed down. Railroad buying, which is always a very large factor in the western market, at once stopped, with the exception of some orders for rails, and general business in the iron and steel trade throughout reductions in finished material since the preceding July. The Republic Iron & Steel Co. announced a price of 1.25c, Pittsburgh, on steel bars; equivalent to 1.43, Chicago, with corresponding reductions in plates and structurals. Independent makers in the west almost simultaneously concurred in this action and the lower quotations were immediately met by the United States Steel Corporation. Thus the steady declines which characterized the last half of the year were inaugurated.

Railroad Buying

As suggested above, railroad buying during the second quarter was confined entirely to rails. Up to May 4, the Rock Island had bought 18,000 tons. About the middle of April, the Harriman Lines purchased 72,000 tons of standard rails divided among the Illinois Steel Co., the Tennessee Coal, Iron & Railroad Co., and the Colorado Fuel & Iron Co. In June, the Missouri Pacific purchased 50,000 tons and during the week of June 22 the Illinois Steel Co. booked scattering orders offered 25,000 tons of various grades of old material, but prices were not considered satisfactory and no sale resulted. This tonnage was again offered in February with similar results, and by Jan. 1, the scrap holdings of this railroad had reached 40,000 tons. Other railroad holdings were heavy and the market correspondingly depressed.

In August, there was the customary reaction from the extreme dullness prevailing in June, and buying was further stimulated by the lower prices which had been established. The consumption, however, was by no means on a scale commensurate to the needs of the mills in the district and the third quarter of the year was marked by steadily declining quotations on all products, and particularly on finished materials. During this period, the western mills ceased to pay any attention to the Pittsburgh base. Each mill acted according to its individual circumstances and took every advantage possible of its geographical position. Chicago mills shipping to western points willingly gave away part of the Pittsburgh-to-Chicago freight in or-

MINIMUM MONTHLY PRICES—CHICAGO MARKET, 1911.

Commodity.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Lake Superior Charcoal, pig iron	$17.50	$17.50	$17.50	$17.50	$17.00	$17.00	$17.00	$17.00	$17.00	$17.00	$16.50	$16.50
Northern No. 2 Foundry, pig iron	15.00	15.00	15.00	15.00	15.00	15.00	15.00	14.50	14.50	14.50	14.00	14.00
Southern No. 2 Foundry, pig iron	15.10	15.35	15.35	15.35	15.10	14.60	14.60	14.35	14.35	14.35	14.10	14.10
Bar iron, f. o. b. mill	1.30c	1.30c	1.25c	1.20c	1.20c	1.20c	1.20c	1.20c	1.20c	1.17c	1.15c	1.12c
Steel bars, f. o. b. mill	1.58c	1.58c	1.58c	1.58c	1.43c	1.43c	1.43c	1.38c	1.33c	1.28c	1.25c	1.20c
Structurals, f. o. b. mill	1.58c	1.58c	1.58c	1.58c	1.53c	1.53c	1.53c	1.53c	1.53c	1.33c	1.30c	1.30c
Plates, f. o. b. mill	1.58c	1.58c	1.58c	1.53c	1.53c	1.53c	1.53c	1.48c	1.48c	1.33c	1.25c	1.25c
Sheets, No. 28 black, store	2.75c	2.75c	2.75c	2.75c	2.75c	2.65c	2.65c	2.65c	2.65c	2.40c	2.40c	2.40c
Plain wire, jobbers' carloads	1.73c	1.73c	1.78c	1.78c	1.78c	1.78c	1.68c	1.68c	1.68c	1.63c	1.53c	1.53c
Wire nails, jobbers' carloads	1.93c	1.93c	1.98c	1.98c	1.98c	1.98c	1.88c	1.88c	1.88c	1.83c	1.73c	1.73c
No. 1 R. R. wrought, net ton	$11.50	$12.00	$11.80	$11.75	$11.00	$11.00	$11.00	$11.00	$10.50	$10.00	$10.00	$10.25
Heavy melting steel, gross ton	11.50	12.00	12.00	11.50	10.25	10.25	10.25	10.75	10.50	10.00	9.75	9.75
Rerolling rails, gross ton	13.50	13.50	13.50	13.00	12.25	12.25	12.25	12.50	12.25	12.25	12.00	12.25

the Chicago territory halted perceptibly. The freight rate decision was the immediate but not the underlying cause of the recession which characterized the second quarter. The decision came at an opportune moment and buyers seized upon it as a pretext for staying out of the market. The real cause of the slowing down so evident during March, April and May, as later events have shown, lay in the artificial level at which prices had been generally maintained.

Out of a total of 11 merchant furnaces in the Chicago territory, only four were in blast at the close of the second quarter and sales of southern iron during these three months had been extremely limited. This indicates the dullness prevailing during this period. Early in May, southern foundry iron was offered at $10.75, Birmingham; a month later it could be obtained at $10.50, and late in June the price dropped to $10.25, but buyers were frightened rather than lured by these changes.

Late in May came the first price amounting to 25,000 tons. Export rail business during this period, for shipment from western mills into Canada, was moderately good. Structural material was much less active during the second quarter and car buying practically at a standstill. In April the reductions in the price of finished materials were foreshadowed by sporadic cutting in the price of plates, which were shaded from $1 to $1.50 per ton by various independent makers. The only important fabricating contract let in the Chicago territory during this period was for the Rothschild building, Chicago, 11,000 tons, which was taken by the American Bridge Co. During May, the plate mill output in the Chicago district fell off severely.

Sheet mill operations were reduced to a basis of 60 per cent capacity late in April and the higher prices on wire placed a damper on buying activities. The scrap market during the second quarter reflected the general dullness and prices fell off from 50c to $1 a ton. In January, the Santa Fe had

der to secure business in competition with eastern mills and later quoted prices without any reference to the eastern market.

In August, Southern No. 2 foundry iron finally settled down on a basis of $10.00, Birmingham, or $14.35, Chicago, and the local furnaces were compelled to reduce their quotations 50c a ton, establishing a price of $14.50 for northern No. 2 foundry. Pig iron buyers, however, were very apparently satisfied that there would not be any rise in prices and steadfastly refused to contract ahead, except on terms wholly unacceptable to the furnace interests. September was one of the quietest months ever experienced in the Chicago pig iron markt. The only encouraging feature at this time was found in the readiness with which specifications against existing contracts were issued and the fact that shipments moved freely.

Rail buying quieted down during the second half, one of the last important contracts being an order for 20,000 tons,

placed by the Santa Fe with the Illinois Steel Co. in October.

There was considerable activity in fabricating contracts in the immediate Chicago district during the early fall and contracts for large buildings were reported almost every week. This was due largely to an artificial condition. The city council passed an ordinance limiting the height of buildings to 220 feet after Sept. 30. On all work started before that date, the height limit was 260 feet. As a result, work on many office buildings and down town structures was rushed. Toward the close of the third quarter, plates and structurals had been cut to 1.25c, Chicago, and bars to 1.20c.

It was not until the last quarter of the year that the drastic price readjustments which had been in progress, and the improvement in the general situation, due to the elimination of such disturbing influences as the freight rate controversy and the trust cases, began to have any effect on the volume of business. The closing months, however, were marked by a swift and steady revival in orders. The lead was taken in this case by the western railroads in placing very heavy car orders. These brought into the market a large tonnage of plates and structurals, also bars, and had a favorable effect on the demand for pig iron. As a result, prices began to show some firmness and it was evident that the long decline had spent itself. As confidence returned, general buyers entered the market more freely and orders for bars, sheets, tubes, wire, etc., grew rapidly. Fabricating contracts showed a noticeable increase in November and December.

At the same time, an extremely heavy buying movement in southern pig iron took place, which culminated during the week of Dec. 11, when fully 30,000 tons were sold in western territory, practically all of it for delivery over the first half of 1912. During this movement the price broke under $10 and in some cases No. 2 foundry was sold as low as $9.50, Birmingham. But the buying movement rallied the market and the year closed with the price of $10, Birmingham, firmly established and higher quotations prevailing for extended future delivery.

As a result of the improvement which took place during the last quarter, makers of finished materials were able to raise their prices approximately $1 per ton during the latter part of December. As the year closed, it was evident that the long period of liquidation had not been without its effect and the market is now apparently established on a firm and stable basis. The outlook for permanent constructive work during 1912 is exceedingly bright. The iron and steel trade in the west is at present in a more healthy condition than it has been for over four years.

A study of the new construction in this territory during the past year shows one of the reasons why the recent heavy orders have not had more effect on prices. The capacity of the district has increased greatly. The following summary details the more important plants which were built in the middle west during 1911:

Blast Furnaces

Ironquois Iron Co., Chicago.—Two 300-ton furnaces for foundry, basic and malleable pig iron were completed during 1911. A description of this plant presented elsewhere in this issue.

The Inland Steel Co., Chicago.—Work was commenced on a second furnace of 400 tons daily capacity at the Indiana Harbor plant. This stack will blow in early in 1912.

Steel Works

Indiana Steel Co.—The 18-inch, 14-inch, 10-inch and two 12-inch merchant mills at the Gary plant were completed in the spring. Their total annual capacity is 600,000 tons. These mills roll rounds, flats and squares, also beams up to 6 inches and 5 x 3-inch angles. Described in THE IRON TRADE REVIEW, March 9, 1911.

Indiana Steel Co.—Sixty-inch universal plate mill at the Gary plant. Completed in May. Annual capacity of 240,000 tons. Described in THE IRON TRADE REVIEW, June 22, 1911.

Indiana Steel Co.—Sheet bar mill at Gary. Completed in June. Annual capacity 480,000 tons. Described in THE IRON TRADE REVIEW, July 13, 1911.

Illinois Steel Co.—New structural mill at South Works. Completed in May. Designed to roll beams and channels from 4 to 8 inches, 3 x 2½ to 6 x 4-inch angles, rail joints, tie plate, etc. Capacity, 180,000 tons per year. Described in THE IRON TRADE REVIEW, June 15, 1911.

Globe Seamless Steel Tubes Co., Milwaukee.—Tube mill. Completed in January. Manufactures seamless steel tubes, 24 feet long, from ½-inch diameter, 14-inch gage, to 4 inches outside diameter, with ½-inch walls. Annual capacity, 24,000 tons. Described in THE IRON TRADE REVIEW, Jan. 26, 1911.

Inland Steel Co., Chicago.—Bolt, nut and rivet department at Indiana Harbor plant, completed in September. Annual capacity, 30,000 tons. Described in THE IRON TRADE REVIEW, Sept. 28, 1911.

American Bridge Co.—New fabricating plant at Gary. Completed in May. Two units, 700 x 300 feet. Annual capacity, 120,000 tons. Described in THE IRON TRADE REVIEW, May 18, 1911.

Foundries

The Crane Co., Chicago.—Continuous malleable foundry. Five stories, 177 x 225 feet. Described in THE IRON TRADE REVIEW, May 11, 1911.

Prescott Malleable Iron Co., Milwaukee.—Malleable foundry. Completed in October. Equipped with two 14-inch air furnaces. Described in THE IRON TRADE REVIEW, Nov. 9, 1911.

French & Hecht, Davenport, Ia.—Continuous gray iron foundry. Completed in the summer. Annual capacity, 12,000 tons. Described in THE IRON TRADE REVIEW, Oct. 26, 1911.

International Harvester Co. — New gray iron foundry at Milwaukee. Completed in summer; 779 x 150 feet in size. Described in THE IRON TRADE REVIEW, Oct. 5, 1911.

Manufacturing Plants

Kempsmith Mfg. Co., Milwaukee.—New plant for manufacture of milling machines. Completed early in the year. Machine shop, 300 x 250 feet; power house, 100 x 50 feet. Described in THE IRON TRADE REVIEW, Feb. 23, 1911.

Bettendorf Axle Co., Davenport, Ia.—Car plant and steel foundry. Completed in the spring. Capacity, 25 all-steel freight cars and 150 steel underframes daily. Described in THE IRON TRADE REVIEW, April 6, 1911.

Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill.—Steel car building plant. Completed in April. Capacity, 28 steel cars daily. Described in THE IRON TRADE REVIEW, April 27, 1911.

National Brake & Electric Co., Milwaukee.—New plant, including large steel foundry and machine shop. Completed in the summer. Described in THE IRON TRADE REVIEW, Nov. 23 and Nov. 30, 1911.

New Auxiliary Loading Device for Iron Mines

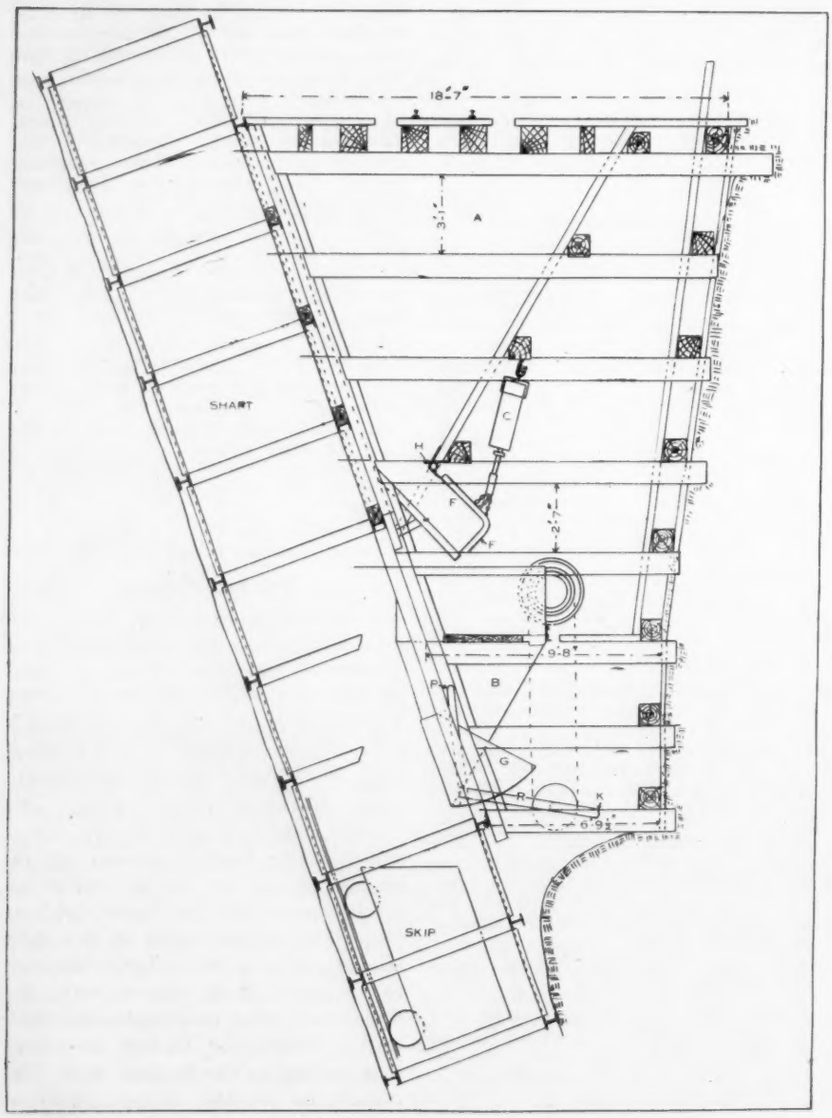
A new auxiliary loading device embodying several novel features has been installed by the Oliver Mining Co. in its two shafts at the Pioneer mine on the Vermillion range. Its use has effected a very large increase in the hoisting capacity of the shafts, particularly when handling lumpy ores. The Pioneer mine is located at Ely, Minn., and the skip loading devices are installed at present on the thirteenth level about 1,200 feet below the surface. One of the shafts at this mine is vertical while the other is inclined at an angle of 70 degrees with the horizontal. The accompanying illustration shows the loading device as it is applied to the inclined shaft. The installation in the vertical shaft is practically the same.

Features of Construction

The device consists essentially of two hoppers, *A* and *B*, with suitable chutes and gates connected to each. The lower hopper, *B*, which discharges into the skip, is designed to hold exactly five tons or one skip-load of ore, and is fitted with a special self-closing gate, *G*, controlled from the loading platform by a hand wheel. The upper hop-

per is immediately under the tracks in the main haulage drift and is so arranged that the mine cars discharge into it directly by gravity. It has a capacity of 60 tons or 12 skiploads. The gate on the large hopper is a special design which will be explained in detail later.

In handling lumpy ores, the chute of the large hopper frequently becomes clogged so that it is necessary to pry the mass loose with a crowbar. All of this work takes time, and when the auxiliary pocket, which is the special feature of this device, is not employed the skip is frequently kept waiting at the bottom of the shaft while the attendant bars the clogged ore from the chute. As a result, the skip is idle a large per cent of the time and the hoisting capacity of the shaft is correspondingly decreased.



LOADING DEVICE AS APPLIED TO AN INCLINED SHAFT

The auxiliary hopper, being small and provided with an extra large gate, does not clog, but discharges its entire contents into the skip at once. As soon as the skip is loaded, it is started on its way to the surface and while it is gone the attendant refills the auxiliary hopper and is ready for the next load before the skip returns to the bottom of the shaft. If any bar work is necessary to induce the lumpy ore to flow freely from the large hopper, there is plenty of time to do it while the skip is being hoisted to the surface and returned.

As shown in the illustration, the large hopper is 14 feet, 3 inches wide at the top, 12 feet deep and approximately 14 feet in length. It is supported on 10 x 10-inch timbers and the sides are composed of 4-inch planks lined on the inside with steel plates. The track and floor on the main level are supported on 12 x 12-inch and 6 x 12-inch stringers laid on the uppermost 10 x 10-inch cross timber. The back side of the hopper, next to the shaft, has an incline of 70 degrees and the front side 60 degrees.

The principal features of the chute leading to the auxiliary hopper are indicated in the illustration. It has an angle of 45 degrees and is lined on the bottom with 3-inch plank. It is 18 inches high and 3 feet long.

The gate in this chute is of peculiar design, specially constructed to control the lumpy ore. It consists of a number of heavy steel fingers, *F*, hinged at *H*, and controlled by the air cylinder, *C*. When the attendant wishes to fill the auxiliary hopper, he simply turns on the air, which causes the piston to act and hoist the restraining fingers out of the chute. The angle at which the chute is set is such that the flow automatically stops when the auxiliary hopper is filled, and when the air is released, the heavy fingers fall back into place. Since each finger is independent of the others, being attached to the air cylinder yoke by a chain, the presence of lumps in the ore does not interfere with the operation of the gate.

The Gate

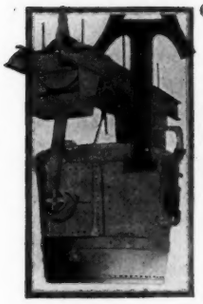
The gate on the auxiliary hopper is swung from the pivot, *P*. It will, therefore, open automatically through the pressure of the ore from the inside and will close of its own weight when the hopper is empty. Premature or accidental opening of the gate is prevented by the connecting rod, *R*, and crank, *K*, which is normally on dead center and rests on the timbers at the floor of the pit. On the crank shaft is mounted a sprocket connected by chain to a similar sprocket on the hand wheel shaft, *G*. The gate cannot open until the attendant rotates the hand wheel a sufficient amount to release the crank, *K*, from its dead center position.

This device has been thoroughly tested and in handling lumpy ores it will increase the hoisting capacity of a shaft from 30 to 50 per cent above that prevailing when using a single hopper. It also insures each skip being properly loaded and prevents spilling, since the auxiliary pocket holds an exact skipload of ore and no more. At the Pioneer mine a hoisting record of 18 skips in 20 minutes has been attained with this apparatus. Each skip-load was hoisted 1,200 feet.

The Geo. M. Newhall Engineering Co., Philadelphia, dealer in new and relaying rails, is distributing a valuable calculation table for tonnages based on 2,240 pounds.

A Modern Acid Open-Hearth Steel Foundry

Description of the Arrangement and Equipment of the New Steel Casting Plant Erected by the Union Steel Casting Co., Pittsburgh



TO MEET the constantly growing demand for steel castings, the producing capacity, in recent years, has been greatly increased. Many new plants have been built and extensions to existing shops, of no mean proportions, have been made. The expanding steel casting requirements of the railroads has resulted in a rapid growth of the basic and acid open-hearth melting capacity and the demand for small cast steel sections, notably for the automobile trade, has led to the recent installation of numerous converters. The tonnage for the railroads, of course, is greatly in excess of that of any other industry, and many of the large open-hearth steel casting plants specialize in that line of work.

The largest and most notable of the recent steel foundry extensions is plant No. 2 of the Union Steel Casting Co., Pittsburgh. This foundry adjoins this company's plant No. 1 and has increased the steel casting output of the works to 3,600 tons monthly. The layout and general arrangement of the departments of this new shop are unique and measure up to the most modern and best designs of foundry engineering. The equipment consists of devices, which are known from years of experience, to effect great economies in steel foundry practice.

Layout of the Plant

A plan of plants Nos. 1 and 2 is illustrated in Fig. 12. It will be noted that the property is bounded by Butler street and the Allegheny river and that the power house and pattern sheds are on the opposite side of the tracks of the Allegheny Valley railroad, which run through the property. An overhead bridge has been built over these tracks to remove the danger of crossing and renders the power plant and pattern sheds easy of access. The layout of the entire works, to a large extent, was governed by the topography of the site, as the street is on a level considerably higher than the Allegheny Valley tracks. In the erection of both plants a large portion of a hill had to be excavated and as the floors of the foundries are considerably above the level of the tracks, concrete retaining walls almost entirely surround both shops. The buildings of plant No. 1, in length, parallel one of the side lines of the property, whereas plant No. 2 has been built parallel to the street and railroad tracks and the successive manufacturing operations carry the product across the works at right angles to the length of the buildings.

Railroad sidings for the receipt of raw material and the shipment of castings extend into both plants. The spur which serves the stock yard of plant No. 2 is depressed a sufficient depth to bring the floors of freight cars and the yard on the same level and concrete retaining walls have been built on either side of this track. The siding into the finishing shop has been depressed from 4 to 8 feet below the floor level, as illustrated in the view of the annealing furnaces, Fig. 3, and the foundry floor is supported by a concrete wall.

As shown in the cross-section of

FIG. 1—TAPPING SIDE OF THE ACID OPEN-HEARTH FURNACES

Plant of Union Steel Casting Co. at Pittsburg, Pa.

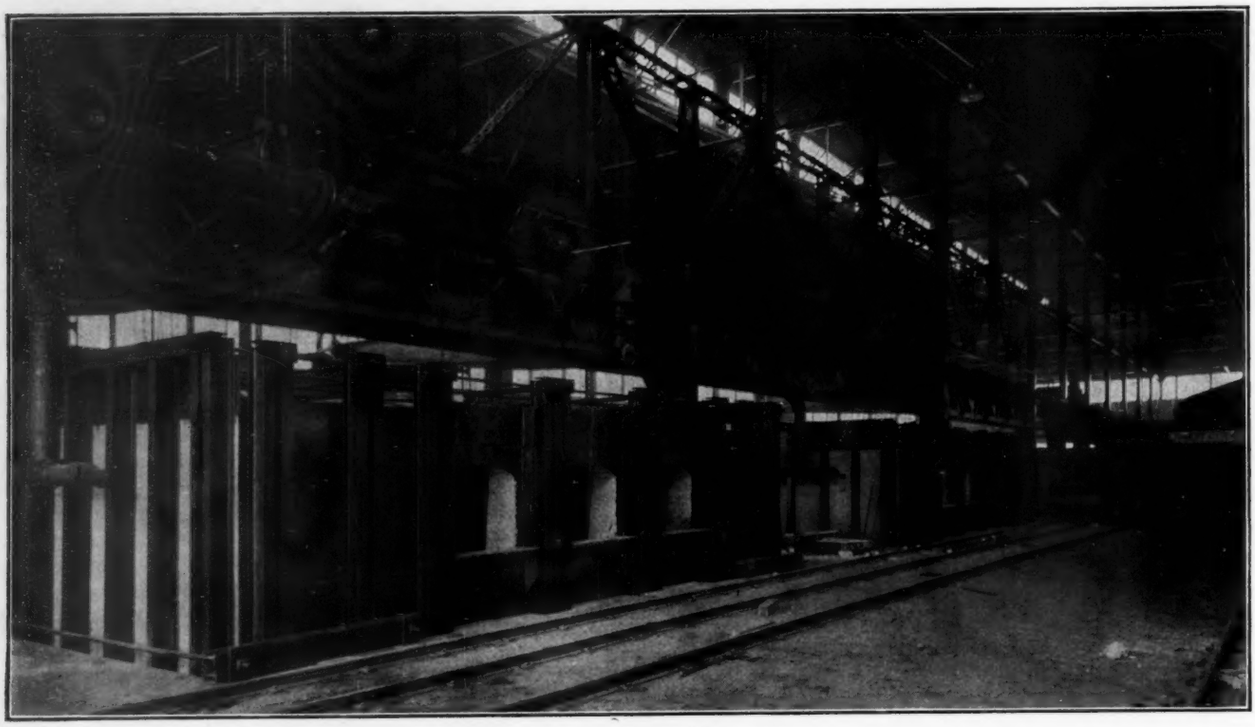


FIG. 2—THE OPEN-HEARTH FURNACE CHARGING FLOOR.

Plant of Union Steel Casting Co. at Pittsburg, Pa.

the new plant, Fig. 14, the foundry consists of three communicating main buildings, practically under one roof. As previously stated, the sequence of manufacturing operations is across the width of the plant and the various processes can be readily followed, in regular order, in this illustration. The molding department for bench and small floor work is near the street line, as shown in the plan, Fig. 12. The molding floor for large work adjoins the dog house and the core shop, core and mold drying ovens are in a lean-to between the large work molding floor and the casting shop. All of the ovens are used for drying both molds and cores and have doors at both ends to permit of delivering the dried molds to the casting floor from the molding departments. After shaking-out the castings are delivered to the finishing shop by a transfer crane, Fig. 7, to the cranes in this department which convey the castings to the machines for the various finishing operations. As shown in Figs. 7 and 14, the finishing shop is on a level slightly below that of the other departments, and a concrete retaining wall supports the floor of the furnace room and the casting shop on the finishing department side. Fig. 4 is a view diagonally across the shop from the heavy molding floor, which shows the transfer crane, open-hearth furnaces and the finishing shop in the distance.

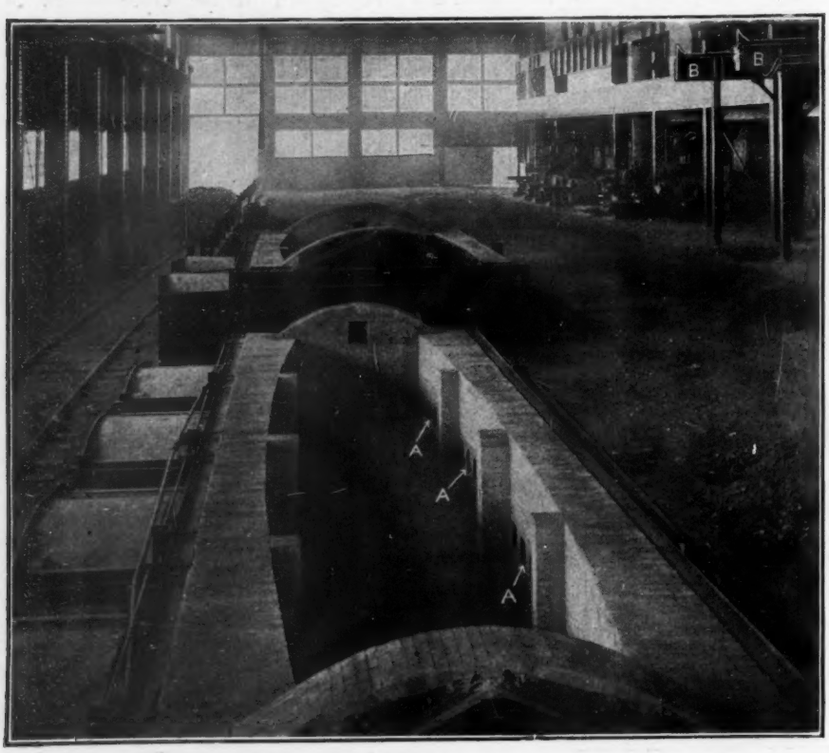


FIG. 3—FURNACES FOR ANNEALING STEEL CASTINGS; THE ONE IN THE FOREGROUND IS ESPECIALLY ADAPTED FOR LOCOMOTIVE FRAMES

Construction of Buildings

The buildings are of steel construction, the columns being supported on concrete piers. The side walls, to heights varying from 6 to 10 feet, are built of concrete, and between the windows and the eaves the buildings are enclosed with corrugated iron sheathing. The molding floors and core shop are in one building, the small work molding floor being located in a lean-to, 200 feet x 34 feet, 11 inches, the heavy work floor in the middle bay, 280 x 58 feet, and the core department is in the other lean-to, 240 feet x 39 feet, 9 inches. In the adjoining building are located the casting shop and furnace department.

FIG. 4—A VIEW ACROSS THE PLANT, SHOWING THE CORE DEPARTMENT, FURNACES, TRANSFER CRANE AND THE FINISHING SHOP IN THE DISTANCE

The casting floor covers an area, 280 feet x 63 feet, 6 inches, and the furnace room is 140 x 37 feet. As the open-hearth furnaces only occupy a space one-half the length of this building, a gallery floor has been built beyond the transfer crane runway in which the store room is located. The finishing shop is 71 x 300 feet and adjoins the furnace department and casting shop.

Ample light and ventilation are provided by rows of sliding windows in the sides and ends of the buildings and by the pivoted sash in the monitors, which is operated in 40-foot sections by pendent chains. For artificial illuminatino, 50, 500-watt Mazda lamps have been installed at sufficient heights to clear the cranes.

Melting Equipment

The melting equipment consists of two 25-ton acid open-hearth furnaces, designed and built by Wm. Swindell & Bros., Pittsburgh. Ample space has been provided for the installation of a third furnace. The furnaces are fired with natural gas, but are also equipped for the use of oil in the event of a failure of the natural gas supply. The oil is stored in two 10,000-gallon gravity discharge tanks and is distributed by two duplex Worthington pumps. The charging floor of the furnaces, Fig. 2, is 26 feet, 5 inches wide and is covered with steel plates to a point a short distance from the fronts of the furnaces. The space between the furnaces and the steel floor is covered with castings, thereby obviating the warping of the charging floor directly in front of the furnaces. The charging machine track is 11-foot gage and the track for the charging buggies is 3-foot gage. The electrically-driven charging machine is of the high type, 10,000 pounds capacity, built by the Morgan Engineering Co., Alliance, O. The charging platform extends into the stock yard a distance of 20 feet and on this extension the charging boxes are loaded onto the charging buggies by the yard crane. The space under-

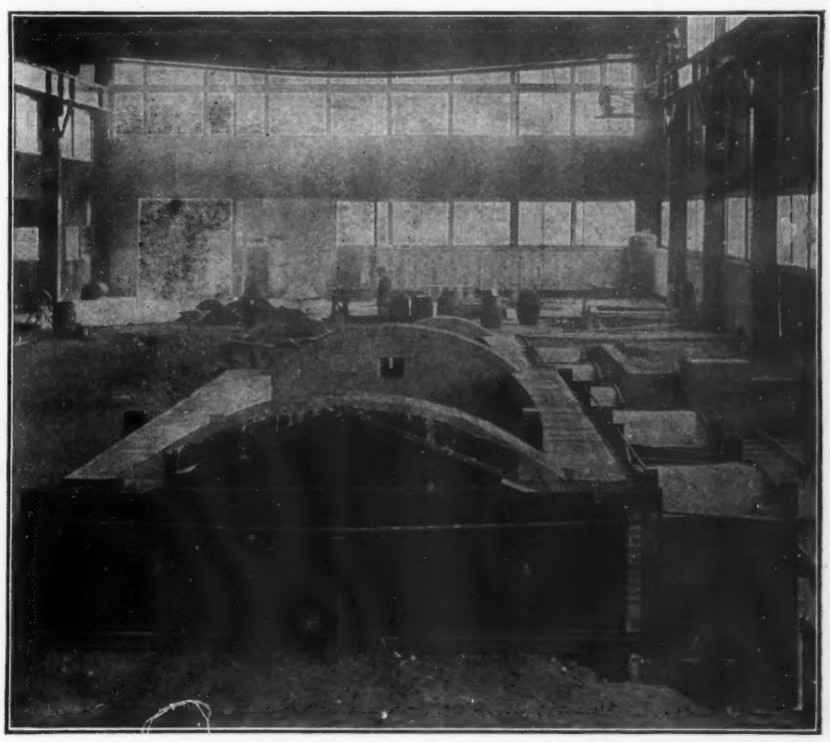


FIG. 5—THE LARGE FURNACE WHICH IS USED FOR ANNEALING DRIVING WHEEL CENTERS AND MISCELLANEOUS WORK

FIG. 6—A VIEW OF THE MOLDING SHOP, SHOWING THE SMALL WORK DEPARTMENT AT THE RIGHT AND CORE OVENS AT THE LEFT

neath this platform in the yard is used for the storage of ore and furnace supplies. The tapping side of the open-hearth furnaces is illustrated in Fig. 1. The ladles, it will be noted, are set into pits, which extend slightly below the level of the casting shop floor.

The charging buggies are of exceedingly simple design, the platform consisting of one-piece steel castings. A rib extends the full length of the car platform, which engages with a slot cast into the bottom of the charging box and serves to center the box on the car platform.

Mold Drying Equipment

Views of the molding floors at opposite ends of the shop, with the drying ovens at the left and the light work floor at the right are shown in Figs. 6 and 8. When these photographs were made the drying ovens were in course of construction. The oven tracks extend into the molding shop a short distance to facilitate the placing of the molds onto the drying oven buggies. The core and mold-drying equipment consists of three double track ovens, 19 x 42 feet; six single track ovens, 9 x 42 feet; two ovens, 6 x 8 feet and one, 10 x 13 feet. The ovens are all 9 feet high and the tracks are 60-inch gage. The ovens are designed to burn either gas or crude oil. The drying oven cars have one-piece cast steel tops fitted with axles and wheels.

The opposite end of a battery of ovens, with the doors raised, is illustrated in Fig. 17. This is a view of one end of the casting shop and

FIG. 8—ANOTHER VIEW OF THE MOLDING ROOM, SHOWING THE END OF THE SHOP OPPOSITE THAT ILLUSTRATED IN FIG. 6

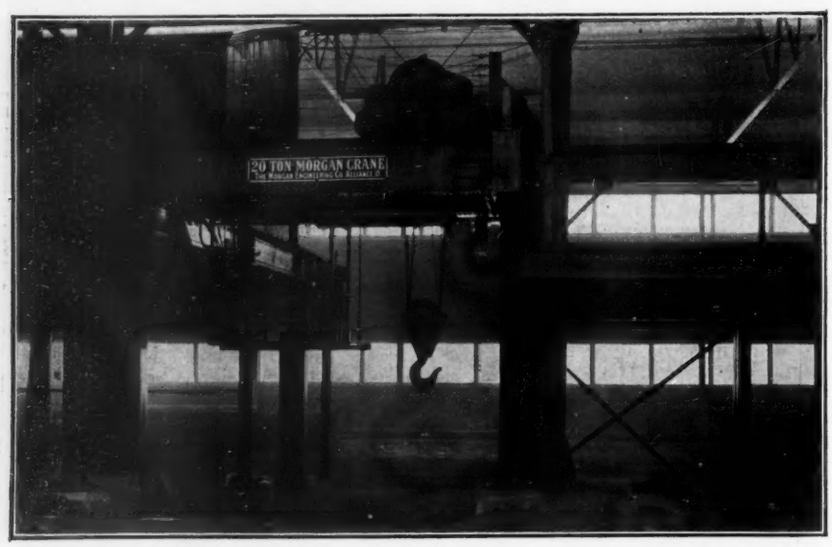


FIG. 7—THE TRANSFER CRANE LEADING FROM THE CASTING TO THE FINISHING SHOP

shows the discharge side of the ovens. After the molds have been dried they are removed from the ovens in the casting shop and placed on the floor, where they are closed ready for casting. At the left in Fig. 17 is shown a brick-lined casting pit, 22 x 17 feet and 9 feet deep. The walls are arched for increased strength as the weight of the castings on the foundry floor has a tendency to crowd in the sides of the pit. The pit, it will be noted, is surrounded by a railing to guard against the danger of the employes falling into this opening in the foundry floor.

Finishing Department

After the castings are shaken-out they are transferred to the finishing department by the transfer crane, Fig. 7. The crane runway is 20 feet wide

and the crane has a capacity of 20 tons. Fig. 15 is a general view of the finishing shop, showing the machine tools at the left and the concrete retaining wall at the side of the shipping track, at the right. All of the finishing tools are arranged along one side of the shop with the annealing ovens at one end. As the Union Steel Casting Co. makes a specialty of locomotive frames, in addition to its other line of railroad and jobbing work, it became necessary to install tools of a sufficient size to finish these large cast steel sections as economically as possible and at one setting.

To finish these large steel castings in one operation and with one setting, the large shaper, shown in Fig. 13, was especially designed and built by the Morton Mfg. Co., Muskegon Heights, Mich. This tool has a bed

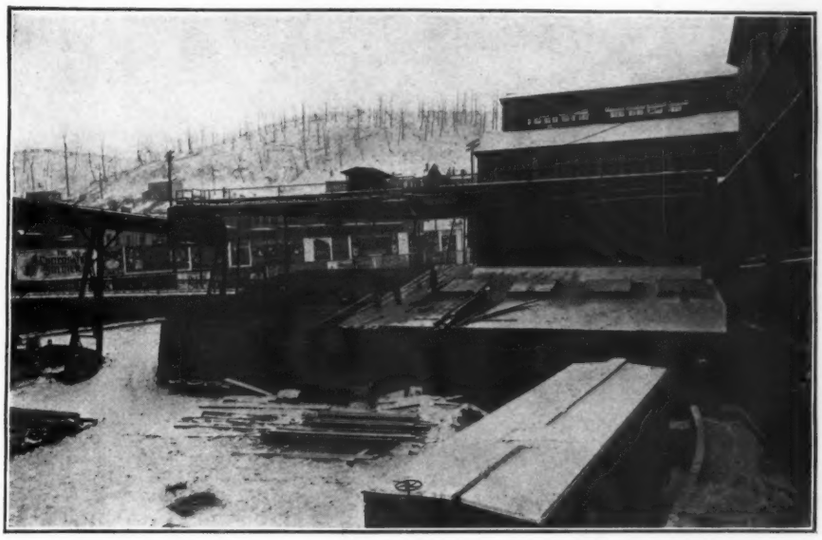


FIG. 10—A VIEW OF ONE PORTION OF THE STOCK YARD, SHOWING THE SAND STORAGE

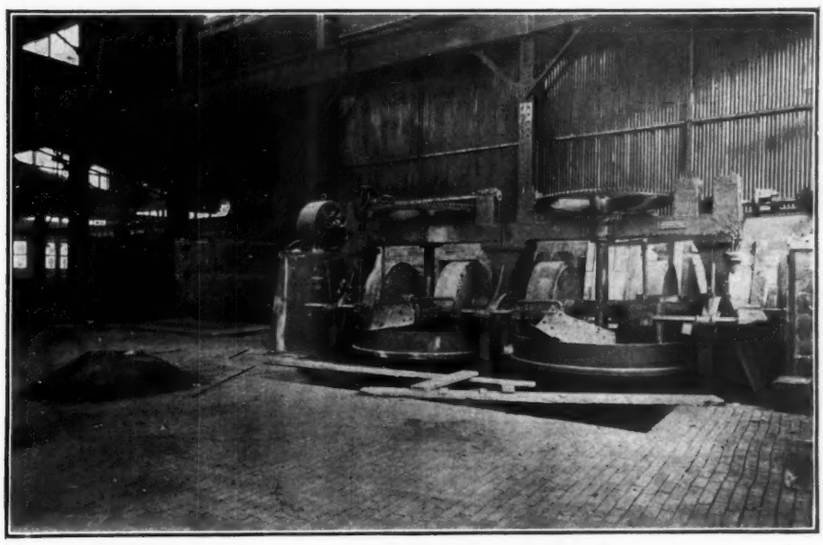


FIG. 9—THE SAND GRINDING PANS

40 feet long, and is equipped with two individual motor-driven traveling heads. This tool has sufficient capacity to remove the heads from the largest locomotive frame in one operation and without resetting. The shaper is equipped with four adjustable work tables. On small work the shaper can operate on two castings at one time. Each traveling head is operated by a 10-horsepower, General Electric motor. The other finishing equipment consists of three Morton, motor-driven shapers, Fig. 16, one of which is equipped with a vise for holding small work; one motor-driven Betts boring mill of the tire-turning type; two motor-driven, Newton cold saws, Fig. 11, respectively, 48 and 30 inches; three swinging grinders driven by 7½-horsepower motors, installed by the Pittsburgh Emery Wheel Co., Pittsburgh; one Bridgeport, motor-driven stationary grinder and a motor-driven, 3 x 6-foot tumbling barrel. The finishing equipment of this shop is unique, inasmuch as all of the tools are driven by individual motors.

Annealing Furnaces

The majority of the castings manufactured by this company are annealed and two large furnaces for this work have been installed in the finishing department. The furnace in the foreground, Fig. 3, has been especially designed for annealing locomotive frames, while the other oven in the background, shown more clearly in Fig. 5, is for miscellaneous work and driving wheel centers. While the annealing of steel castings is being given careful consideration by steel foundrymen, many of the ovens in use are merely brick chambers so de-

FIG. 11—A VIEW IN THE FINISHING SHOP, SHOWING THE MOTOR-DRIVEN CUTTING-OFF SAWS

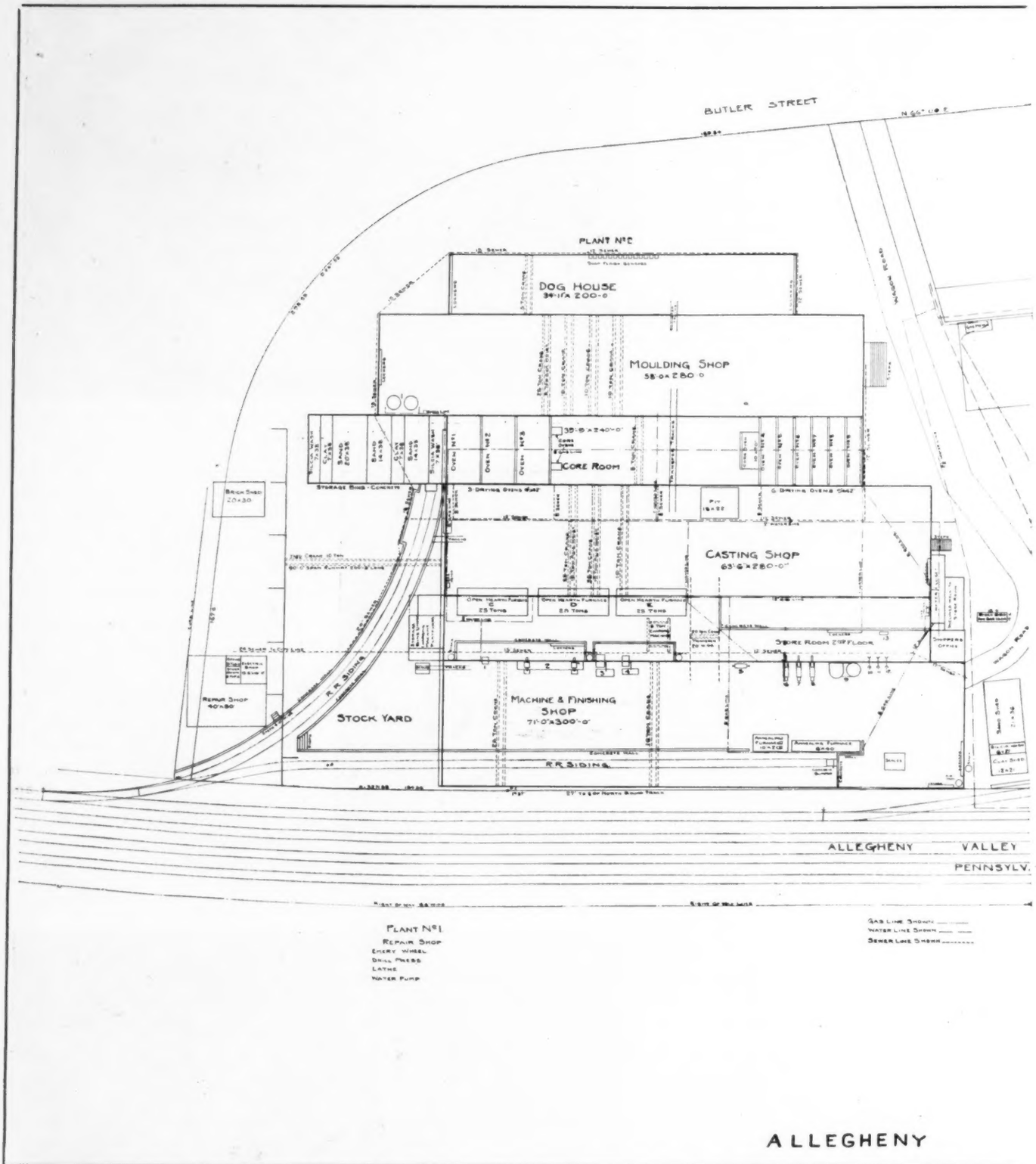


FIG. 12—GROUND PLAN OF THE WORKS OF THE UNION STEEL CASTING CO., PITTSBURGH; PLANT NO. 2 HAS ONLY RE PRACTICE IN STEEL

Key to Ground Plan

Plant No. 1.

MACHINE SHOP.

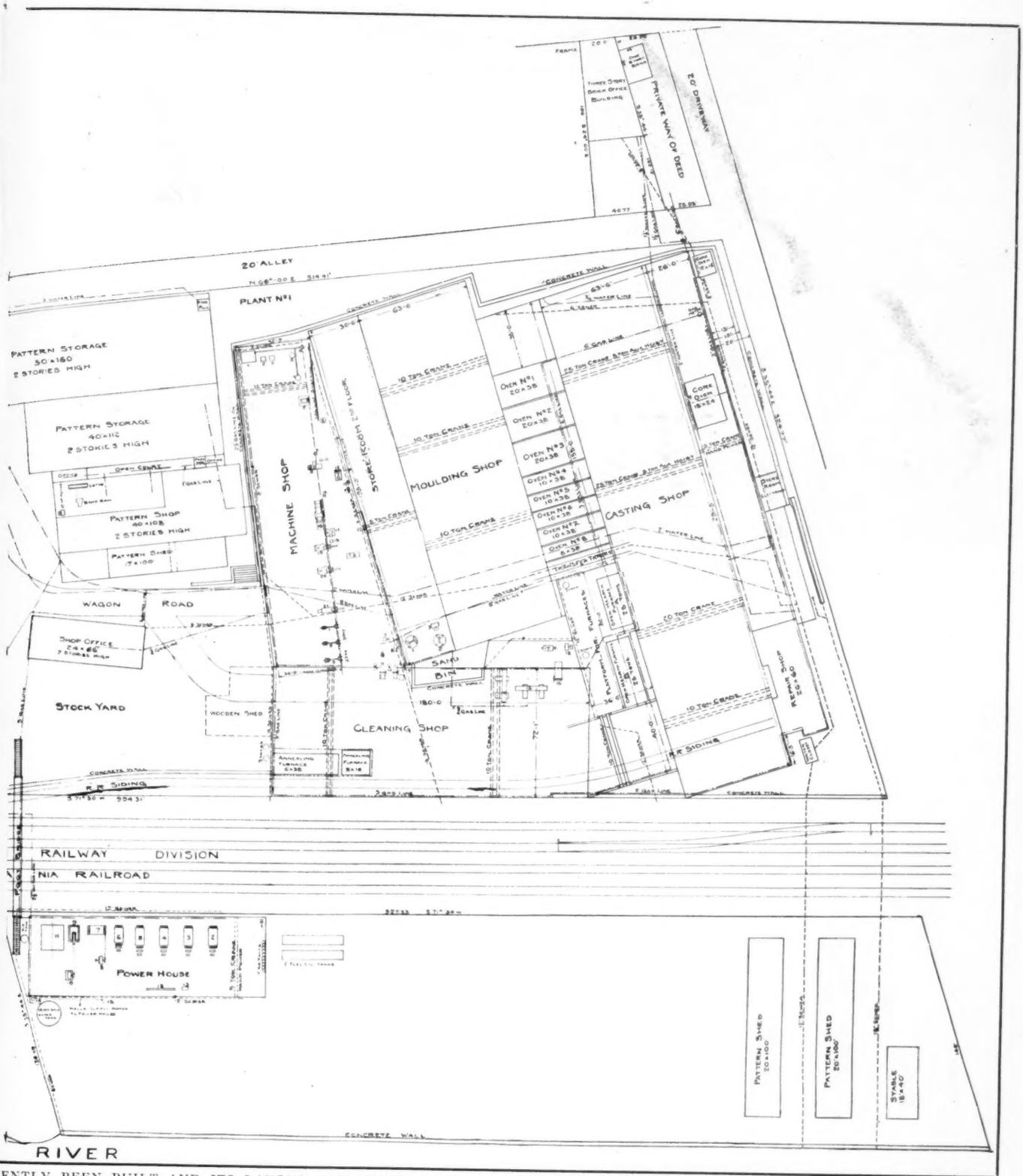
No. 1.—Annealing furnace.
Nos. 2, 3, 4 and 5.—Blacksmith's forges.
No. 6.—Blower.
No. 7.—Hammer.
No. 8.—Air tank.
No. 9.—Tool grinder.
No. 10.—Air pump.
No. 11.—Drill press.
No. 12.—Transformers.
No. 13.—Resistance coil.
No. 14.—Switchboard.
No. 15.—Starting box.
No. 16.—Lathe.
No. 17.—40-horsepower motor.
No. 18.—Starting box.
No. 19, 20 and 21.—Shapers.
No. 22.—Air tanks.
No. 23.—Shears.

CLEANING SHOP.

Nos. 1, 2, 3, 4 and 5.—Emery wheels.
No. 6.—Starting box.
No. 7.—Water pump.
No. 8.—20-horsepower motor.
No. 9.—Starting box.
Nos. 10 and 11.—Cold saws.
Nos. 12 and 13.—7-horsepower motors.
Nos. 14 and 15.—Planers.
No. 16.—Cold saw.
No. 17.—Tumbling barrel.
No. 18.—30-horsepower motor.

MOLDING SHOP.

Nos. 1 and 2.—Sand mill.
No. 3.—20-horsepower motor.



CENTLY BEEN BUILT AND ITS LAYOUT AND GENERAL ARRANGEMENT IS CONCEDED TO REPRESENT THE MOST MODERN FOUNDRY ENGINEERING

POWER HOUSE.

No. 1.—Air pump.
Nos. 2, 3, 4 and 5.—200-horsepower gas engines and generator.
No. 6.—140-horsepower gas engine and generator.
No. 7.—125-horsepower gas engine.
No. 8.—75-horsepower generator.
No. 9.—Air compressor.
No. 10.—60-horsepower motor.
No. 11.—Motor-driven air compressor.
No. 12.—Switchboard.
No. 13.—Motor generator set.
Nos. 14 and 15.—Deep well pumps driven by 5-horsepower motors.

Plant No. 2.

CLEANING AND MACHINE SHOPS.

No. 1.—Blacksmith's forge.
No. 2.—Shaper with two traveling heads.
No. 3. — 20-horsepower, motor-driven cold saw, 48 inches.
No. 4. — 10-horsepower, motor-driven cold saw, 30 inches.
No. 5, 5-horsepower, motor-driven tumbling barrel.
Nos. 6, 7 and 8.—7½-horsepower, motor-driven shapers.
No. 9.—25-horsepower, motor-driven boring mill.
Nos. 10, 11 and 12.—7½-horsepower, motor-driven swinging grinders.
No. 13. — 10-horsepower, motor-driven stationary grinder.

MOLDING SHOP.

No. 1. — 50-horsepower motor-driven sand mill.

FURNACE ROOM.

35-inch motor-driven exhaust fan.

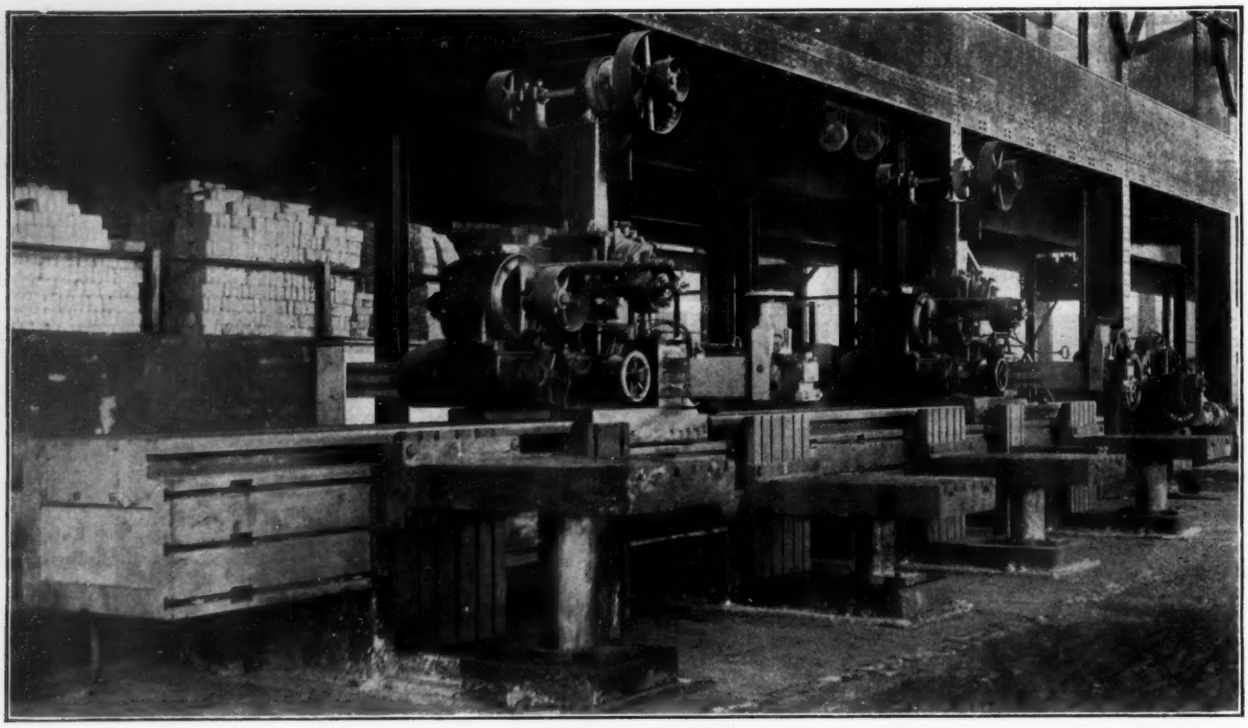


FIG. 13—THE LARGE 40-FOOT SHAPER WHICH IS EQUIPPED WITH TWO MOTOR-DRIVEN TRAVELING HEADS AND FOUR ADJUSTABLE WORK RESTS

signed that the uniform anneal of the sections charged therein cannot be affected. In both these views the covers of the furnaces have been removed to show more clearly the interior construction. The covers are sectional, lined with fire brick and are removed by the traveling cranes.

The furnace for annealing locomotive frames, in the foreground, Fig. 3, is 40 feet long, 6 feet wide and 4 feet deep. The four fire boxes are shown at the left and the downtakes are illustrated at *A*. The furnace is so arranged that the heat enters from the fire boxes, passes over the castings and enters the downtakes, passing through flues underneath the furnace bottom, thereby heating this part of the oven, into the main flue to the 54-inch stack which carries off the

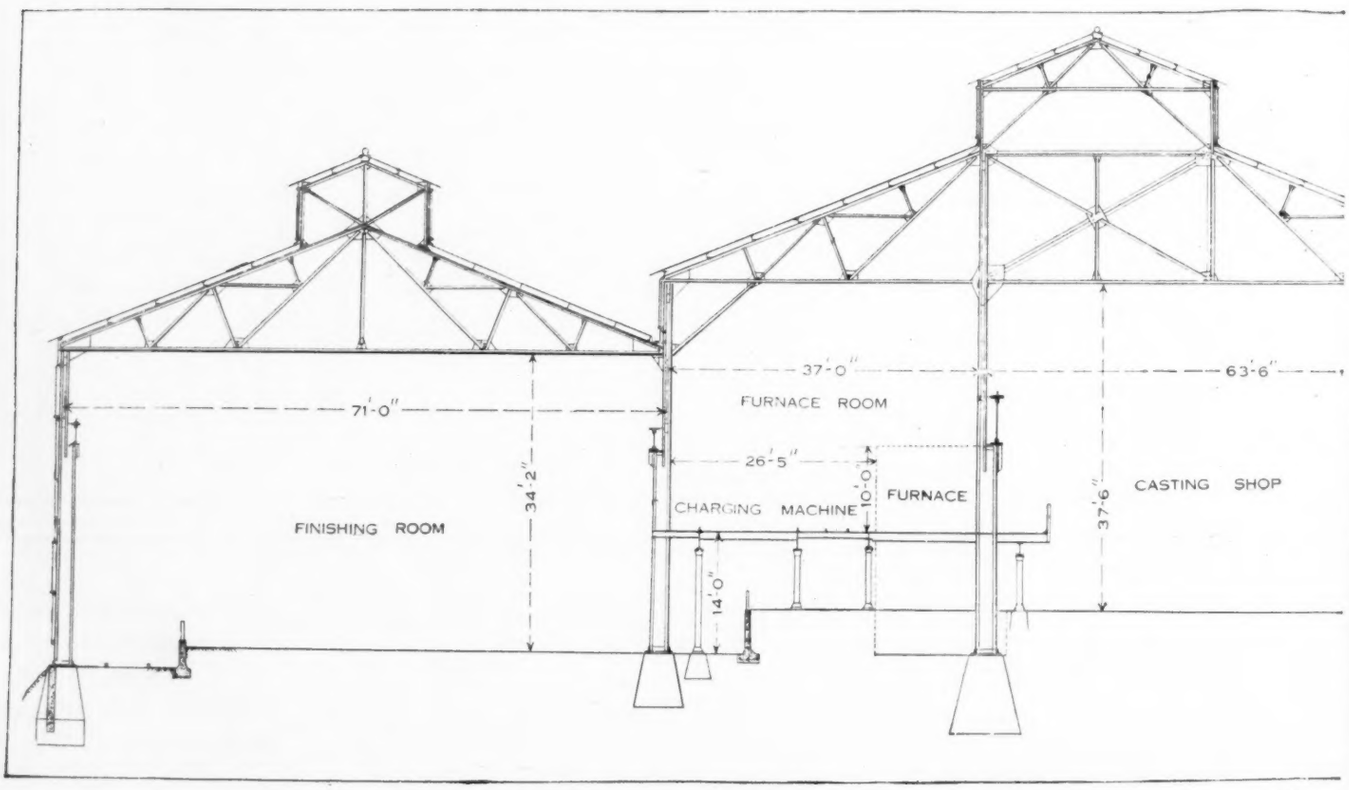
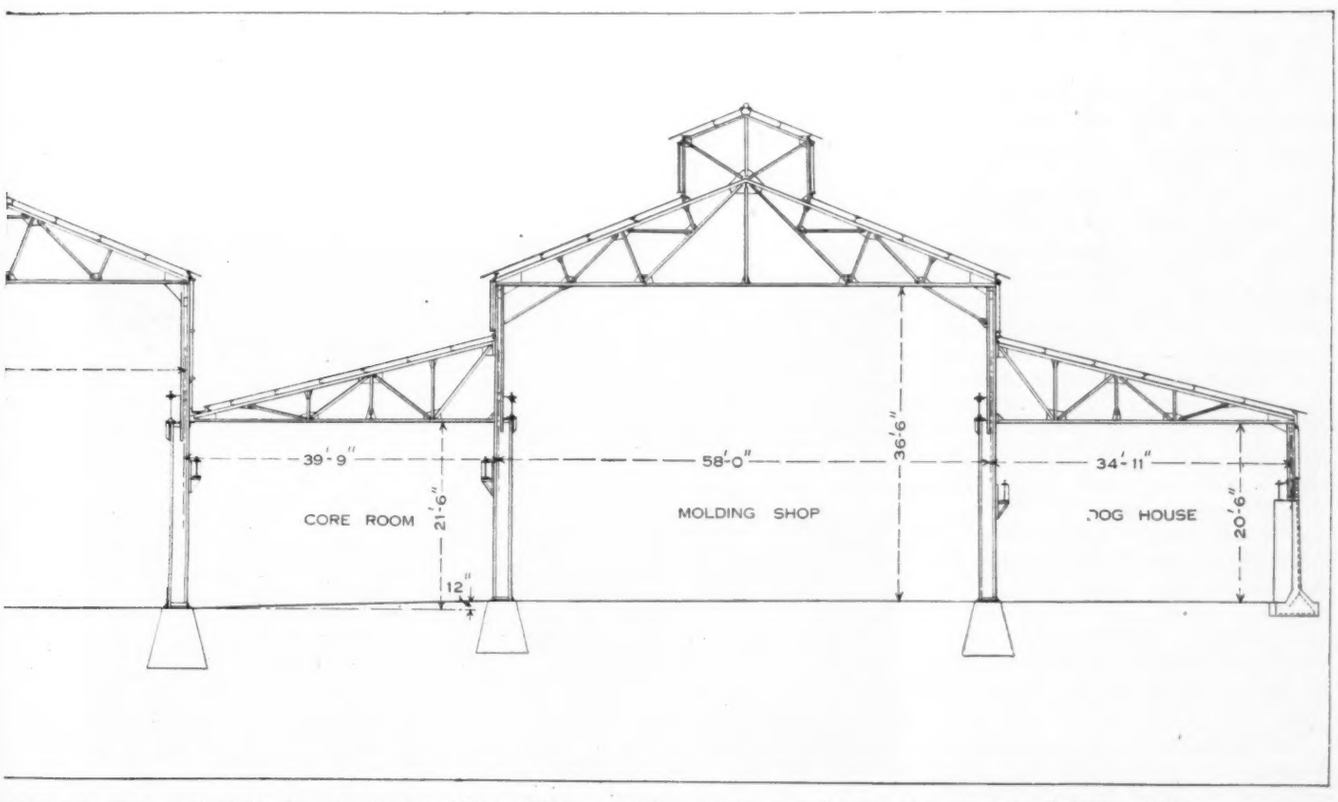


FIG. 14—A CROSS-SECTION OF THE NEW PLANT OF THE UNION STEEL CASTING CO., PITTSBURGH

FIG. 15—A GENERAL VIEW OF THE FINISHING SHOP, SHOWING THE MOTOR-DRIVEN TOOLS ARRANGED IN A ROW AT THE LEFT; THE DEPRESSED TRACK IS AT THE RIGHT

waste gases from both furnaces. The furnace for annealing locomotive driving wheel centers and miscellaneous work, shown in Fig. 5, is 20 feet long, 10 feet wide and 7 feet deep. It is provided with two fire boxes, but otherwise is similar in construction to the furnace for locomotive frames. The havy fire brick walls of both furnaces is a noteworthy feature and as they are built into the ground and only extend slightly above the foundry floor level, the charging and discharging is greatly facilitated. To provide against the caving in of the walls from the pressure of heavy castings on the finishing floor, the walls of the furnaces are arched and, in addition, are braced by steel channels tied together with rods. The ends and sides are further reinforced



SHOWING THE MOLDING DEPARTMENTS, CORE ROOM, CASTING SHOP, FURNACE ROOM AND FINISHING SHOP

FIG. 16—ANOTHER VIEW IN THE FINISHING SHOP, SHOWING THE MOTOR-DRIVEN SHAPERS

with steel plates. The furnaces are fired with natural gas, but are equipped also to burn oil. In Fig. 3, *B* indicates the end of the transfer crane runway which connects the casting with the finishing department. After the castings have been annealed and finished they are loaded onto cars on the depressed shipping track, illustrated at the left, Fig. 3.

The sand-handling, storage and grinding facilities have been designed with a view of effecting the greatest possible economies. The sand is received in the stock yard and is unloaded into buckets from the cars. The buckets are picked up by the yard crane which conveys them to the sand storage and dumps their contents into sand bins through openings in the roof of the sand storage. This building is of concrete construction, 38 x 80 feet, and adjoins the molding shop at the end of the casting building, as illustrated in Figs. 10 and 12. The sand storage has a capacity of 30 carloads, and is divided into seven bins respectively, as follows: Silica wash, 7 x 38 feet; clay, 7 x 38 feet; sand, 20 x 38 feet and 14 x 38 feet; clay, 7 x 38 feet; sand, 14 x 38 feet, and silica wash, 7 x 38 feet. Openings in the roof of the sand storage over each bin are provided, as shown in Fig. 10. When sand is not being unloaded these openings are covered. An opening in the sand storage leads to the sand-preparing plant, Fig. 9, which consists of two motor-driven grinders. From this point the sand is delivered to the various floors in the molding shop.

The stock yard, only a portion of which is shown in Fig. 10, is 90 x 185 feet, and is served by a 10-ton electric traveling crane. All of the raw material for plant No. 2 is received over the depressed track which extends diagonally across the yard to the sand storage. The span of the crane runway is sufficient to command five cars on this track. Scrap, pig iron and other raw materials for the open-hearth furnaces, with the exception of ore and supplies, are stored in the yard where the charging boxes are also filled and deposited on the charging floor extension by the yard crane.

The following crane equipment for the entire plant was furnished by the Morgan Engineering Co., Alliance, O.: Light molding department, one 5-ton; heavy molding shop, three 10-ton and one 25-ton with a 5-ton auxiliary hoist; core room, one 5-ton; casting shop, two 35-ton with 10-ton auxiliary hoists and one 10-ton; transfer crane, 20 tons, 20-foot span; finishing shop, one 25-ton and one 10-ton; yard crane, 10 tons, and power house crane, 5 tons. In addition to the cranes, transfer tracks are provided for conveying flasks from the casting to the molding departments. A brick pavement has been laid in the molding shop and core department to prevent the accumulation of sand, which in time has a tendency to raise the level of the floors. In the finishing shop, for a distance of 60 feet at the shipping end, an asphalt block pavement has been laid. A new fireproof pattern storage building, 50 x 160 feet, two stories high, is now being erected.

The power plant is located on a strip of land between the Allegheny Valley tracks and the Allegheny river. The building is of brick and steel construction, 44 x 135 feet, and is served by a 5-ton crane. The equipment consists of four 200-horsepower Westinghouse gas engine generating sets; one 140-horsepower Westinghouse gas engine generating set; one 125-horsepower gas engine belted to generator; one 400-cubic-foot Franklin air compressor belted to motor; one 1,000-cubic-foot Laidlaw-Dunn-Gordon air compressor direct-driven by a 185-horsepower motor and two 3-cylinder, 50-horsepower, vertical Westinghouse gas engines, belt-connected to generator which furnish power for electric welding devices. Provisions have been made for the installation of an additional alternating current generating set. All of the crane motors as well as those driving the tools in the finishing shop, with the exception of the Morton shapers, are of the Westinghouse type. The controllers are of the Cutler-Hammer drum type.

FIG. 17—A VIEW IN ONE END OF THE CASTING SHOP, SHOWING THE BRICK-LINED CASTING PIT AND A BATTERY OF CORE OVENS AT THE LEFT

Chronology of Iron and Steel Trade in 1911

Principal Events Relating to the Making and Selling of Iron and Steel Products—Also Facts About Men

January 2—Year opens with buyers confining purchases to cover actual needs. S. A. Benner, formerly sales manager of Carnegie Steel Co., becomes assistant to president Pittsburgh Steel Co.

3—Several furnace interests cover for first half coke requirements at $1.60, ovens. W. E. Corey resigns as president of the United States Steel Corporation.

4—American Locomotive Co. books 30 locomotives for Imperial Railroad of Japan. Market on southern pig iron established at $11, Birmingham, for first half delivery.

5—Jones & Laughlin Steel Co. makes new high production record at Aliquippa, Pa., when a single tin mill turns out 21,555 pounds of tin plate in eight hours, compared with 20,170 pounds, previous record at South Sharon.

6—Price of gray forge pig iron advanced 50 cents a ton, sales being made at $13.50, valley.

8—United States Cast Iron Pipe & Foundry Co. buys 42,000 tons gray forge iron for Scottdale, Pa., plant. Slightly heavier inquiry for finished steel products reported.

9—Controversy concerning specifications of Pennsylvania rail order adjusted, but order not formally entered. Stocks of pig iron in middle west, outside Steel Corporation, estimated at 900,000 tons.

10—James A. Farrell, president of the United States Steel Products Co., elected president of the United States Steel Corporation to succeed W. E. Corey.

12—Western Pennsylvania furnace takes 10,000 tons non-Bessemer ore at $4 and gives in exchange 4,000 tons basic pig iron at $13.65, valley. American Sheet & Tin Plate Co. awards contract to William Tod Co., Youngstown, covering run-out tables complete for jobbing and plate mills at Gary, Ind.

13—James T. McCleary made secretary of American Iron and Steel Institute. Connellsville *Courier* places production of coke in the Connellsville region 1910, at 18,689,722 tons.

14—Republic Iron & Steel Co. decides to build 16 and 14-inch combination continuous steel bar mill at Lansingville instead of at Brown-Bonnell plant as originally announced. Automobile manufacturers call for heavier shipments of sheets and shafting.

16—More inquiry for pig iron appears in various centers. Stronger tone in finished material market noted and prices are slightly firmer.

17—Missouri-Pacific buys 2,000 freight cars; Pennsylvania railroad 1,800, and the Santa Fe system 500.

18—New low price $2, ovens, established on first half foundry coke. Cleveland interest buys 6,000 tons prompt furnace coke at $1.40, ovens.

19—Gary Screw & Bolt Co. asks bids for new plant at Gary, Ind., to cost $1,500,000.

20—American Steel & Wire Co. and independents advance prices on wire products $1 a ton. McKeesport Tin Plate Co. completes two new tin mills, making total of 22 mills.

21—Low price on spikes and track bolts withdrawn as a result of increased buying by railroads for first half shipment.

23—Follansbee Bros. Co. completes two new sheet mills at Follansbee, W. Va.

24—New York Central railroad orders 176,750 tons of steel rails. Rail orders of Pennsylvania Railroad Co. accepted by steel companies.

25—Crucible Steel Co. of America buys Midland Steel Co. property at Midland, Pa., and announces plans for new steel works. Sheet manufacturers meet in Pittsburgh, and, with few exceptions, agree to abolish commission on galvanized sheets to jobbers.

26—Wisconsin Steel Co. awards contract to American Ship Building Co. for bulk freighter, 545 feet over all, 525 feet keel, 58 feet beam and 31 feet deep.

27—Some mills advance price of wire rods $1.50 ton to $29, Pittsburgh. United States Steel Corporation increases blast furnace activities from 46 to 55 per cent.

28—American Iron and Steel Association reports production of 27,298,545 gross tons of all kinds of pig iron in the United States in 1910, compared with 25,795,471 tons in 1909.

30—Reports for January make good showing compared with preceding months. Sales of pig iron in Philadelphia territory in January aggregate 75,000 to 100,000 tons.

31—Republic Iron & Steel Co. starts steel mills in full for the first time in several months. Kittanning Iron & Steel Co. buys 20,000 tons of furnace coke for February and March.

February

1—Ten of the 19 merchant furnaces in valley districts are active. Sale of 1,250 tons Bessemer pig iron made at $15, valley.

2—Westinghouse Electric & Mfg. Co. awards contract to American Bridge Co. for two new foundry buildings, Trafford City, Pa. Eugene P. Thomas elected president United States Steel Products Co., succeeding James A. Farrell.

3—Price of tin plate advanced 10 cents per base box, or $2 a ton. Shenango Steamship Co. awards contract to Great Lakes Engineering Works, for two bulk freighters, to be larger than any now afloat.

4—Crucible Steel Co. of America takes over plant of Halcomb Steel Co., Syracuse, N. Y. W. H. McFadden tenders resignation as vice president and general manager Mackintosh, Hemphill & Co., Pittsburgh, effective Mar. 1.

6—United States Steel Corporation buys 5,000 tons 50 per cent ferro-silicon at $55, Pittsburgh. Buying movement in scrap inaugurated at Pittsburgh, some grades advancing $1 a ton.

7—Six thousand tons of valley basic pig iron sold at $13.25, valley, and sellers advance prices to $14 a ton.

8—Official reports show 210 blast furnaces in operation Feb. 1, compared with 193 Dec. 31. Leading cast iron pipe company buys 40,000 tons of lower grades foundry pig iron.

9—Linde Products Co. awards contracts for new plants at Trafford City, Pa., and Elizabeth, N. J.

10—Monthly statistics of unfilled tonnage of the United States Steel Corporation shows gain of 436,162 tons Jan. 31, as compared with Dec. 31.

11—Bulk freighter William C. Agnew, of the Buffalo Steamship Co., is launched at Lorain, O. Sheet manufacturers meet at Pittsburgh and report larger volume of new business.

13—Carnegie Steel Co. is operating its 64 open-hearth furnaces at Homestead, Pa., at 100 per cent of capacity. Cambria Steel Co., Johnstown, Pa., operating all of its 25 open-hearth furnaces.

14—Indiana Steel Co. reports sale of 2,000 tons of open-hearth sheet bars at $25, Pittsburgh, an advance of $1 a ton

15—Plant activities show increased demand for all lines of steel products.

16—Jones & Laughlin Steel Co., Pittsburgh, Eliza group; furnace built nine years ago, orders rebuilding of No. 3 blast furnace, made 1,866,110 tons on original lining.

17—William K. Fleming, private secretary to E. H. Gary, for 11 years, died at East Orange, N. J. Jones & Laughlin Steel Co. awards contract for 12 new tin mills at Aliquippa, Pa., giving a 24-mill plant.

18—Crucible Steel Co. of America buys 2,000 acres of coking coal land in Green county, Pa. American Iron and Steel Association statistics give production all kinds of rails in the United States in 1910 as 3,634,029 tons, an increase of 20.1 per cent over 1909.

20—Approximately 40,000 tons of heavy melting steel sold at Pittsburgh at $14.50, delivered, an advance of $1 a ton. Several large contracts for steel bars placed by farm implement manufacturers for third quarter shipment at 1.40c, Pittsburgh.

21—West Penn Steel Co., Pittsburgh, sells 2,000 tons open-hearth sheet bars at a premium of $1 a ton.

22—Low prices on pig iron in New England and Buffalo territory disappear. Several round tonnages of basic sold at Pittsburgh at $13.50, valley.

23—Bessemer & Lake Erie Railroad Co.'s annual report shows 13,405,401 net tons of freight handled in 1910. Ore shipments dropped from 7,855,298 tons in 1909 to 7,214,296 tons in 1910.

24—Colonial Iron Co., Riddlesburg, Pa., awards contract for a modern blast furnace with daily capacity of 250 tons.

25—Pennsylvania Railroad Co. orders nine additional electric locomotives, aggregating 40,000 horsepower, from the Westinghouse Electric & Mfg. Co.

27—Steel making by Duplex system inaugurated by Bethlehem Steel Co., South Bethlehem, Pa., upon completion of new Bessemer plant. United States Steel Corporation operating 65 per cent blast furnace capacity and 75 per cent finishing mill capacity.

28—Interstate commerce commission's adverse decision on freight rates cast chill over the steel market, although no cancellations of orders are made.

March

1—Republic Iron & Steel Co. buys 100,000 tons furnace coke for delivery over the remainder of the year at $1.72½, ovens. Daily bookings of United States Steel Corporation for February reported between 35,000 and 40,000 tons, compared with 30,000 tons in January.

2—Fires lighted in first battery of 70 of

the Indiana Steel Co.'s 560 ovens adjoining the Gary steel plant.

3—The Texas Co. places order with American Sheet & Tin Plate Co. for 50,000 boxes of tin plate, being the first order placed in this country by this interest. J. W. Dougherty, formerly president Pennsylvania Steel Co., elected president Pittsburgh Crucible Steel Co.

4—Wire manufacturers announce second advance of $1 a ton this year. National Tube Co. is operating Riverside plant full time for first time in months.

6—United States Steel Corporation operating 62 per cent of its blast furnace capacity and orders three additional furnaces into service.

7—Wire rod manufacturers advance price of Bessemer and open-hearth rods to $30, Pittsburgh. Robert Wallace, dean of lake ship builders, died at St. Petersburg, Fla.

8—Manufacturers of tin plate reject orders for fourth quarter shipment at today's price, $3.70, f. o. b. Pittsburgh.

9—R. D. Nuttall Co., Pittsburgh, buys Hydraulic Machine Co.'s property, Pittsburgh, for $400,000. The railroads continue to buy cautiously.

10—Coke market is more active and prices firmer. Sales include 100,000 tons to an eastern steel company, and 45,000 tons to the Pittsburgh Crucible Steel Co. for delivery over the next three months.

11—Prices on No. 2 foundry pig iron for second half established at $14.25, valley, by 2,000-ton sale to Iron City Sanitary Mfg. Co., Pittsburgh.

13—Cambria Steel Co. and Republic Iron & Steel Co. operate all blast furnaces for first time in several months. W. B. Dickson resigns as first vice president of the United States Steel Corporation, effective April 1.

14—New arrangement made whereby three western mills now figure in bi-monthly bar iron card settlement. Adjustment shows 1.30c card, reducing wages of puddlers 12½c a ton for March and April.

15—Average daily bookings of leading steel makers show slight decline compared with previous months.

16—Jones & Laughlin Steel Co. awards contract to Morgan Construction Co. for a new wire rod mill at Aliquippa, Pa., which will give the company an annual output of 200,000 tons of rods. T. J. Bray elected president of the Republic Iron & Steel Co., succeeding T. W. Guthrie, resigned.

17—An eastern steel company buys 5,000 tons of ferro-manganese for delivery to March, 1912, at slightly under $37, Baltimore.

18—Prices on several grades of scrap decline 50 cents a ton and entire market shows weakness.

20—Sheet manufacturers open books for third quarter business at today's prices. Nut and Bolt Makers' Association meets in New York and reaffirms prices.

21—Cut nail makers at Philadelphia advance prices $2 a ton to $1.70, Pittsburgh. Pig Iron stocks at steel works' furnaces in Pittsburgh and Ohio districts considerably lower than a month ago.

22—Report of American Iron and Steel Association shows production of steel ingots and castings in the United States in 1910, was 9,412,772 tons, a gain over 1909, of 81,989 tons.

23—Canadian consumers buy 50,000 tons of basic pig iron, one company taking 20,000 tons.

24—Standard Oil Co. awards contract to American Bridge Co. for three barges with capacity of 1,000,000 gallons each.

25—Bulk freighter Thomas Walters, of Jones & Laughlin Steel Co., launched at Lorain, to replace the W. C. Moreland, wrecked October, 1909.

27—Railroad spike manufacturers announce quotation of $1.55, Pittsburgh, will be withdrawn Mar. 30, representing an advance of $1 a ton.

28—Leading tin plate producers announce production during first quarter established new high mark.

29—American Locomotive Co. buys 12,000 tons of iron at less than $13.75, Buffalo.

30—Southern pig iron producers establish a basis of $11, Birmingham, for No. 2, for fourth quarter shipment.

31—United States Steel Corporation in March booked new business at rate of 35,000 tons daily, compared with 40,775 tons in February. American Steel & Wire Co. broke all records for shipments in March.

April

1—Production of coke and anthracite pig iron in March was 2,157,399 tons, an increase of 376,114 tons the previous month.

2—Andrew S. Upson, president of the Upson Nut Co. and the Union Rolling Mill Co., died at Cleveland.

3—Some independent tin plate mills accept orders for fourth quarter delivery at $3.80, Pittsburgh, an advance of 10 cents per base box.

4—Dr. R. W. Raymond resigns as secretary of the American Institute of Mining Engineers.

5—Consumers of pig iron and finished material are more cautious in placing orders. Evidence of price cutting appears in sheet market.

7—United States Steel Corporation appropriates $400,000 for erection of home for employes at its southern plant.

8—Price concessions of 50 cents a ton made on open-hearth billets and sheet bars.

10—Some western mills offer concessions of $2 a ton on plates. All centers report decline in demand for finished materials.

11—United States Steel Corporation's unfilled tonnage report as of March 31, shows 3,447,301 tons, an increase of 46,758 tons. Shipments in March were 79 per cent of maximum output and bookings were at rate of 83 per cent.

12—Iron ore operators meet at Cleveland and informally discuss ore situation, but do not take definite action on prices for 1912.

13—Sheet manufacturers meet at Pittsburgh and reaffirm prices. Sheet mills are operating at about 50 to 60 per cent of capacity.

14—New wire mills Cambria Steel Co., Johnstown, Pa., were placed in service.

15—Further concession of $1 a ton offered on open-hearth billets and sheet bars.

17—Shipments of iron ore from lake mines started with price situation unsettled, the first loading being done by Corrigan, McKinney & Co. United States Steel Corporation blows out several furnaces, its active capacity now being slightly under 70 per cent.

18—Pittsburgh & Lake Erie railroad buys 2,000 coke cars.

20—Steel is being made at the new open-hearth plant of the Upson Nut Co., Cleveland.

21—Sales of basic pig iron in the east amounting to 10,000 tons have fixed $15, delivered, as the prevailing price.

22—Price concessions on finished material more general, 1.35c, Pittsburgh, being openly quoted on plates.

23—Annual report of the Pennsylvania Steel Co. for the year 1910, shows total income of $4,029,125, an increase of $22,846.

24—Iron ore prices are reduced 50 cents a ton from last year's prices. A Pittsburgh interest selling 555,000 tons.

25—Wire rod market shows further weakness and sales are made at $29, Pittsburgh, a reduction of $1.

26—Alexander E. Brown, president of Brown Hoisting Machinery Co., died at Cleveland.

27—Lake freight rates on ore reduced from 70 cents to 60 cents from the head of the lakes.

28—Basic pig iron market established at $13.50, valley, by actual sales.

29—Demand for finished material declines and is reflected in decreased activity of blast furnaces and rolling mills.

May

1—Steel Corporation bookings in April were 25,000 tons a day, compared with 35,000 tons a day in March. Coke and anthracite pig iron production in April was 2,044,786 tons, decrease of 119,978 tons. John Reis elected a vice president of the United States Steel Corporation, succeeding W. B. Dickson, resigned.

2—Nineteen steel works furnaces and eight merchant stacks were blown out in May.

3—Prices on iron boiler tubes are very irregular. Low quotations are made on bar iron.

4—Statistics show March exports of iron and steel tonnage lines showed gain of 60,946 gross tons, or 39.4 per cent over any previous month in the history of export movement.

5—United States Steel Corporation acquires property of Risdon Iron & Locomotive Co., Portrero, Cal., to be used as base for distribution of products along the Pacific coast.

6—New interests acquire holdings in Baldwin Locomotive Works, Philadelphia. Bethlehem Steel Co. awards contract for by-product coke plant near Didier, Pa.

8—E. A. S. Clarke, president Lackawanna Steel Co., made chairman of new standing committee on welfare work of the American Iron and Steel Institute. An Ohio steel company buys 3,000 tons basic pig iron on a basis of $13, valley.

9—Pig iron stocks in yards of steel works and merchant furnaces, in Ohio and Pittsburgh territory, increase 13,000 tons in 30 days.

10—National Tube Co. receives order for 40 miles of 6-inch steel line pipe for delivery in Wyoming.

11—Bi-monthly examination of bar iron sales sheets show 1.25c bar card, which means a further reduction of 12½ cents per ton in puddlers' wages for May and June.

12—Steel bar manufacturers' meeting shows strong sentiment in favor of maintaining prices.

13—Demand for wire products declines and price concessions are offered by some mills.

15—Sentiment in iron trade improves as result of assurance by the supreme court in

the tobacco trust decision that business will be regulated without being destroyed.

16—Committee is appointed by national house of representatives to inquire into the United States Steel Corporation with regard to its origin and manner of operation.

17—National Tube Co. receives an order for 8,000 tons of steel line pipe for Mexico. Some mills offering concessions of $2 a ton on black and galvanized sheets.

18—Malleable pig iron sold at $13.35, valley, the lowest price in two years.

19—More than 15,000 tons of heavy melting steel sold at Pittsburgh at $13, delivered, an advance of 50 cents a ton. Jobbers are advised that contracts for wire nails previously made at $1.75, Pittsburgh, will be terminated June 1.

20—Agricultural interests hold up contracts for steel bars in anticipation of lower prices.

22—William W. Sly, president of the W. W. Sly Mfg. Co., died. Manufacturers of blue annealed sheets meet active competition from plate mills by selling No. 10 gage as low as 1.55c, Pittsburgh.

23—Annual convention of the American Foundrymen's Association opens at Pittsburgh, with the president, Major Joseph T. Spear, presiding.

24—Republic Iron & Steel Co. surprises trade by cutting price of steel bars $3 a ton. All officers of the American Iron and Steel Institute are re-elected at annual meeting.

25—United States Steel Corporation closes negotiations for coking coal holdings of the Pittsburgh Coal Co. and Monongahela River Consolidated Coal & Coke Co. in western Pennsylvania at about $18,000,000.

26—Furnace coke market quiet and weak, sales being made as low as $1.40, ovens. Major Joseph T. Spear re-elected president of American Foundrymen's Association. Buffalo chosen as place for 1912 convention.

29—Officials of the United States Steel Corporation and independent steel companies meet in New York and decide upon a general cut in prices effective June 1, as follows: Billets and sheet bars $2 a ton; steel bars $3 a ton; black and galvanized sheets $4 a ton; plates and shapes $1 a ton.

30—Spring meeting of the American Society of Mechanical Engineers opens at Pittsburgh.

31—Manufacturers at a meeting in New York enter into a lengthy discussion of labor conditions with a view of possible reduction in wages to conform to lower prices of steel. John J. Spearman, one of the oldest iron masters in the country, and head of the Spearman Iron Co., died at Sharon, Pa.

June

1—Jones & Laughlin Steel Co., through New York and Chicago bankers, places an issue of $10,000,000 5 per cent bonds.

2—Frank D. Stalneker appointed receiver for the Brown-Ketcham Iron Works.

3—Judge E. H. Gary appeared before investigating committee at Washington and makes a frank statement in which he declares Sherman act inadequate and favors government control of prices.

5—Merchant and independent steel works furnaces in Pittsburgh and Ohio territory reduce stocks 13,500 tons.

6—Annual wage scale conference between Amalgamated Association of Iron, Steel and Tin Workers and the Western Bar Iron Association opens at Cambridge Springs, Pa., the former asking for a renewal of the 1910-11 wage scale.

7—Lower prices finished steel do not develop new business. Period of waiting sets in. Forging billets cut $2 a ton. New discounts on shafting down $3 a ton. Oil country pipe cut $2 to $3 a ton.

8—Carnegie Steel Co. purchases stock and warehouse of the Bassett-Presley Co., Cleveland.

9—Dr. Paul Heroult announces United States Steel Corporation has acquired all his rights in the United States and Canada relating to his electric processes and furnaces used in manufacture of steel and iron products.

10—Wisconsin Steel Co. and Inland Steel Co. join Connellsville Coke Producers' Association in complaint to the interstate commerce commission against proposed advance of 15 cents a ton in freight rates on furnace coke from Connellsville, Pa., to Chicago.

12—Four of the eight new 60-ton open-hearth steel furnaces, blooming mill and sheet bar mill of the Republic Iron & Steel Co., at Youngstown, O., are placed in service.

13—Annual report of the Westinghouse Electric & Mfg. Co. for the year ending Mar. 31, shows gross earnings, $38,119,312, an increase of $9,000,000 over 1910, and $5,000,000 over the best previous year the company ever had. Youngstown Sheet & Tube Co., Youngstown, authorizes increase in capital stock from $10,000,000 to $15,000,000.

14—Less despondency noted in market centers, although price situation offers little encouragement. A sale of 1,000 tons of No. 2 foundry iron made to Pittsburgh consumers at new low price of $13.50, valley.

15—New pig iron tariff announced, advancing freight rate from Ironton and Ohio furnaces to Moline, Ill., territory from $2.10 to $3.75 per ton. Charter granted to Canadian Vickers, Ltd., Montreal, with a capital stock of $5,000,000 to build large ship yard at Montreal.

16—Big Stone Gap blast furnace at Big Stone Gap, Va., sold at court sale to local investors. Sharon Steel Hoop Co. completes 14-inch mill for rolling wide bands and strips.

17—Bethlehem Steel Co. closes for large lot of Swedish and Lake Superior ores. Cleveland furnace interest buys 8,000 tons furnace coke at $1.40, ovens.

19—Steel plant of Tennessee Coal, Iron & Railroad Co., Ensley, Ala., resumes operation. Mill orders of Carnegie Steel Co. for first half of June exceed May orders by 100,000 tons.

20—Canadian Car & Foundry Co. places an order with the United States Steel Products Co., for 50,000 tons of plates to cover car contracts on hand.

21—New price card on wire products shows reduction of $2 a ton, making prices same as at beginning of the year.

22—Interstate commerce commission vacates suspension order against flat freight rates on coke from the Connellsville, Pa., region and announces new flat rates effective July 15. Steel making operations United States Steel Corporation about 68 per cent of capacity, the best record so far this year, except brief period in March.

23—Independent sheet and tin plate manufacturers renew 1910-11 wage scale agreement with the Amalgamated Association of Iron, Steel and Tin Workers. The Reeves Mfg. Co., Canal Dover, O., awards contract to Lewis Foundry & Machine Co., Coraopolis, Pa., for four hot sheet mills, making a total of six new mills this year.

24—Pittsburgh sellers report sales of 250,000 tons of furnace coke for last half shipment at $1.65 to $1.75, ovens. Lower prices on sheets bring out larger volume of business and mill operations are increased.

26—Large eastern buyer takes 20,000 to 25,000 tons of standard mill forge iron for last half. Radiator interest, Johnstown, Pa., buys 9,000 tons No. 2 foundry iron at $13.50, valley.

27—Republic Iron & Steel Co. reaffirms wage scale of the Amalgamated Association of Iron, Steel and Tin Workers, for the year beginning July 1, puddlers to receive $5 a ton on a 1c bar iron card.

28—Half year business of the United States Steel Products Co. estimated at 1,000,000 tons, which is at a rate of one third increase over two preceding years.

29—One large steel company at Pittsburgh reports gain of 40 to 50 per cent in bookings of rails and crude steel in June over May.

30—Erie railroad enters market for 4,000 cars. Illinois Central asks bids on 2,000 cars.

July

1—Howard Wood, president, Alan Wood Iron & Steel Co., died at Philadelphia. Bulk freighter Col. J. M. Schoonmaker, of Shenango Steamship Co., launched.

3—Production pig iron for first half given as 11,411,405 tons, decrease 3,342,044 tons, compared same period 1910. Iron ore shipments in June were 4,826,505 tons, compared with 3,684,319 tons May this year, and 7,316,592 tons June, 1910.

5—Usual July shutdown of sheet and tin mills is not general on account of increased buying. Eastern makers offer concession of $1 a ton on steel bars, quoting 1.20c, Pittsburgh.

6—Wire rod market weak. Pittsburgh mills quote $27. Pending inquiries involve 10,000 to 12,000 freight cars.

7—Production of coke in the Connellsville region for the second quarter given as 3,784,349 tons, compared with 5,318,245 tons, same period previous year.

8—Western Bar Iron Association renews Amalgamated Association wage scale for one year, this being the last wage scale under negotiation.

10—Valley furnaces report sales 20,000 tons basic pig iron at $12,65 to $12.75, valley, a reduction of 35 cents a ton. Price railroad spikes reduced from $1.60 to $1.50, Pittsburgh.

11—Two eastern Pennsylvania consumers buy 12,500 tons basic pig iron $15, delivered.

12—Concessions of $1 a ton on steel bars and bar iron more general.

13—Price on plates reduced from 1.35c to 1.30c, Pittsburgh. Demand for old material increases and prices are advanced 25 to 50 cents a ton.

14—Pittsburgh car wheel interest buys 1,000 tons of malleable for last half shipment $15.35, valley, a reduction of 25 cents a ton.

15—Estimated that 95 per cent of the agricultural implement makers in the Mississippi valley have covered for steel bar requirements at 1.25c, Pittsburgh.

17—Republic Iron & Steel Co. buys 60,000 tons basic pig iron from the Struthers Furnace Co. for delivery over 10 months, giving iron ore in exchange. American Rolling Mill Co. buys 15,000 tons of basic iron at $13, valley.

18—Pig iron stocks in Pittsburgh, valley and Ohio territories decline 11,000 tons during first half of July. The United States Steel Corporation operating 70 per cent of its total capacity.

19—Several mills quote 1.20c, Pittsburgh, on steel bands, a reduction of $1 a ton. Ferromanganese sells at new low price of $36.50, Baltimore.

20—George R. Young and Dixon Boardman appointed receivers for the Platt Iron Works

Co., Dayton, O. Republic Iron & Steel Co. awards contract for a 90-inch plate mill at Lansingville, O.

21—Lebanon Valley Iron & Steel Co., Lebanon, Pa., increases capital stock $1,000,000 and absorbs Duncannon Iron & Steel Co., Duncannon, Pa.

22—Prices of black and galvanized sheets reduced $1 a ton to 1.95c to 2.95c, Pittsburgh, respectively. American Sheet & Tin Plate Co. starts six sheet mills at Aetna-Standard plant, and is now operating 75 per cent of available capacity.

24—Price of ferro-manganese reduced 50 cents a ton to $36, Baltimore. Wire mills of the United States Steel Corporation operating at 73 per cent and tube mill capacity increased to 72 per cent.

25—Sharon, Pa., consumer takes 15,000 tons basic pig iron at $13.25, valley, bringing total sales in Pittsburgh district to 100,000 tons within three weeks. Judge Archbald, United States district court, New York, imposed fines ranging from $1,000 to $1,700 on 27 out of 83 officials of wire manufacturing concerns indicted June 29, on charges of violating Sherman anti-trust act.

26—On account of increased building activity, American Bridge Co. decides to rehabilitate the American Works, Chicago, and increase annual output to 35,000 tons. United States Steel Products Co. receives order for 1,500 tons line pipe and 7,000 boxes tin plate for export.

27—H. S. Haselton, secretary-treasurer of ore mining property of Pickands, Mather & Co., died at Cleveland.

28—Minnesota Steel Co., Duluth, awards contract to Pennsylvania Engineering Works, New Castle, Pa., for two blast furnaces.

29—Mather ticket elected at annual meeting Westinghouse Electric & Mfg. Co. E. M. Herr elected president, succeeding Edwin F. Atkins.

31—Efforts of southern furnaces to advance quotations from $10.25 to $10.50, Birmingham, for No. 2 iron checks buying.

August

1—Extension of blast furnace operations results in noticeable gain in coke production and prices are firmer.

2—Consumption of scrap increases and central west and eastern dealers realize higher prices.

3—Jones & Laughlin Steel Co. completes new wire rod mill at Aliquippa, doubling wire rod capacity.

4—United States Steel Corporation operating at 77 per cent of its capacity.

5—Purchase of 12,000 tons of foundry iron by Westinghouse Electric & Mfg. Co. establishes market at $13.50, valley, for No. 2.

7—Leading interest takes 16,000 tons of plates and shapes for Canadian shipment. Revised specification for Quebec bridge calls for an additional 14,000 tons, bringing total to about 65,000 tons to be rolled by domestic mills.

8—United States Steel Corporation in five weeks reduces its pig iron stocks 75,000 tons.

9—John W. Gates, dominant factor of Republic Iron & Steel Co., and the Texas Co., died at Hotel Meurice, Paris, after a lingering illness.

11—Unfilled tonnage statement of United States Steel Corporation as of July 31, shows 3,584,085 tons, gain of 223,027 tons since June 30, despite the fact that shipments of finished steel products in July reached highest point so far this year.

12—H. C. Frick Coke Co. starts 1,200 additional ovens and is operating 70 per cent of its capacity.

13—Steel Corporation blows in five additional blast furnaces, making total of 73 per cent of blast furnace capacity active.

14—Mills maintain good rate of activity, but new business is light and prices irregular.

15—Lukens Iron & Steel Co. buys 10,000 tons basic pig iron at slightly under $15, delivered. Nearby Pittsburgh furnace exchanges 10,000 tons basic iron for billets and finished steel.

16—Two Pittsburgh consumers buy 15,000 tons No. 2 foundry iron at $13.50, valley. Erie Railroad places orders for 4,500 freight cars.

18—Pittsburgh Crucible Steel Co. awards contracts for new buildings at Midland, Pa.

19—E. W. Parker, United States geological survey, issues report giving production of coke by by-product ovens in 1910, as 7,138,734 net tons, against 6,254,644 tons in 1909, and 4,201,226 tons in 1908.

21—Media Gas & Fuel Co. awards contract for 60 miles of 10-inch gas line pipe to National Tube Co.

22—Some independent mills offer concession of 10 cents per base box on tin plate.

23—Basic pig iron situation in the east shows more strength and $15, delivered, regarded as the bottom.

24—Chicago ordinance limiting height of buildings to 200 feet, effective Dec. 1, results in work being started on a number of new structures.

25—Pittsburgh mills reduce price of wire products $1 a ton, market level being $1 a ton lower than at the beginning of the year.

26—Mill operations sustained by heavy specifications, but new business is light and prices ragged.

28—Westinghouse Air Brake Co. purchases site for plant at Emeryville, Cal., to better serve customers in Japan, China and far eastern countries.

29—New orders and specifications for pipe checked by rumors of new official card to become effective Sept. 1.

30—Scrap market shows weakness and embargoes declared against shipments to several plants.

September

1—Ore shipments during August were 7,548,311 tons, compared with 6,964,381 tons in August, 1910, decrease 1,416 070 tons; movement to Sept. 1, 1911, 19,606,068 tons, as against 28,827,029 tons same period 1910, decrease 9,220,961 tons.

2—Pig iron production in August given as 61,687 tons, an increase of 4,399 tons over July.

4—Industrial plants observe Labor day.

5—Structural steel market leads in activity. One large independent western Pennsylvania steel company closes books for the remainder of the year.

6—John Williams elected president of the Amalgamated Association of Iron, Steel and Tin Workers, succeeding P. J. McArdle, resigned.

7—Mills offer concessions $1 a ton on wire products and tin plate, and $1 to $2 a ton on sheets.

8—Francis L. Robbins, former president Pittsburgh Coal Co., died in Chicago.

9—Prices on steel bars reached lowest mark of the year, sales being made at 1.15c, Pittsburgh.

11—Youngstown Sheet & Tube Co. buys 4,000 tons of ferro-manganese for 1912 delivery at $13, seaboard, this being largest sale in months.

12—By-monthly bar iron card settlement shows 1.20c card and reduces puddlers' wages 12½ cents a ton to $5.50 for September and October.

13—Jones & Laughlin Steel Co. completes 12 new tin mills at Aliquippa, giving the company a 24-mill plant with annual output of 2,000,000 boxes.

14—Small mills grant concession $1 a ton on open-hearth billets and sheet bars. Demand for boiler tubes far below capacity of mills and price concessions are freely obtained.

15—Youngstown Sheet & Tube Co. awards contract to the American Bridge Co. for buildings to house new open-hearth furnaces and blooming mill, requiring 7,500 tons of steel.

16—Annual report La Belle Iron Works for year ending June 30 shows decrease 24 per cent in value of shipments as compared with preceding year. Open-hearth sheet bars sold at Pittsburgh at $19.50, mill.

18—Basic pig iron market reaches lowest level in years, a valley furnace selling 1,000 tons at $13.50, delivered, Pittsburgh, or $12.60, valley.

19—Jones & Laughlin Steel Co. buys 6,000 tons ferro-manganese, 1912 delivery, at $37.50, Baltimore. Extreme cuts of $2 a ton on sheets bring out slightly larger volume of business for immediate shipment.

20—Co-operative spirit among steel manufacturers weaker than in a long time and leading interest and independents drift farther apart. Central west and eastern railroads buy 40,000 to 50,000 kegs of spikes.

21—Outlook for market on wire products improves with seasonable buying. Price concessions on finished products disturbs market for both buyers and sellers.

22—New department of United States Steel Products Co. organized to handle Steel Corporation's business on Pacific coast.

23—Knox Pressed & Welded Steel Co.'s new plant, Niles, O., formally opened.

25—Alan Wood Iron & Steel Co. and J. Wood Bros. Co. announce reduction in wages of 10 per cent for skilled labor and 5 per cent for common labor, effective Oct. 1.

26—Pennsylvania Railroad Co. asked for bids on 14,000 tons of foundry iron for Altoona shops.

27—Joseph Leon Gobeille, well known pattern maker and engineer, died at Niagara Falls, N. Y.

28—Production of all kinds alloyed steel ingots and castings in 1910, according to American Iron and Steel Association, was 567,819 tons, increase 385,839 tons.

29—United States Geological Survey gives aluminum production in the United States in 1910, as 47,734,000 pounds, compared with 32,210,000 pounds in 1909.

30—Iron ore shipments in September were 5,231,069 tons, decrease 1,042,763 tons, compared with the same month last year. Output of anthracite and coke pig iron in September was 1,968,503 tons, an increase of 43,761 tons over August.

October

2—New basing card merchant iron and steel pipe effective today shows following reduction: Black steel $2 a ton, all sizes except ⅜ and ½ inch, which is $4 a ton; $6 to $14 a ton galvanized steel pipe; $2 a ton all sizes extra strong and double extra strong. Iron pipe: $2 a ton several sizes black pipe;

$4 to $10 a ton on galvanized butt-weld and $4 to $12 on galvanized lap-weld.

3—Bessemer pig iron market, which was firmly held at $15, valley, for more than a year, finally broken by sale of 1,000 tons to a Cleveland consumer at $14.65, valley. The basic average for September announced as $12.66, valley, the lowest in years.

4—National Tube Co. receives an order from Canadian Western Gas, Light, Heat & Power Co., for 40,000 tons line pipe, the largest ever awarded.

5—Philadelphia consumer buys 6 000 tons basic; western Pennsylvania steel company buys 5,000 tons low phosphorus iron; Pennsylvania railroad buys 5,000 tons foundry grade for Altoona shops.

6—Production of coke Connellsville region third quarter, 1911, given as 3,963,915 tons, lowest for the same period since 1906, but gain of 5 per cent over second quarter of this year.

7—Pennsylvania railroad buys 10,000 tons additional foundry iron for Altoona shops. Eastern Pig Iron Association reports decline in stocks in September greater than for any month this year. Bulk freighter Col. James M. Schoonmaker makes maiden trip from Ecorse yards to Toledo.

9—Several fairly large orders for cars placed by eastern roads. Car builders figuring on 20,000 cars.

10—Carnegie Steel Co. issues new warehouse price list on steel bars, plates and shapes, to conform to reductions made recently by steel mills.

11—Western mills in many instances disregard Pittsburgh as a basing point, quoting f. o. b. mill.

12—Western Steel Corporation placed in hands of receiver to serve until creditors choose a trustee. Pittsburgh Crucible Steel Co. awards contracts for mill engine and other equipment for new plant at Midland, Pa.

13—The Texas Co. places order for 150 miles of 6-inch steel pipe with Republic Iron & Steel Co. A western interest enters market for 250 miles 8 to 10-inch steel pipe.

14—Tennessee Coal, Iron & Railroad Co. gives General Electric Co. largest contract for turbine driven centrifugal blowers that has yet been placed in this country for installation at Corey, Ala., consisting of nine separate units of large and varied capacities.

16—Leading interest and independents announce reduction of 20 cents per base box or $4 per ton on tin plate for first half shipment, the market being quotable at $3.40, Pittsburgh. Announcement is made that open-hearth steel plant with annual capacity of 100,000 tons will be built at Detroit.

17—Pittsburgh Crucible Steel Co. disposes of 30,000 to 40,000 tons of pig iron in exchange deals. Contracts amounting to 75,000 tons of structural steel pending in the east.

18—Eastern ship builders buy plates at 1.25c, delivered, equivalent to 1.10c, Pittsburgh. Wire mills are operating at about 85 per cent of capacity. Charles W. Gates elected a director of the Republic Iron & Steel Co. to succeed his father, John W. Gates.

19—International Motor Co. incorporated with capital stock of $10,000,000 to conduct commercial management of Sauer motor truck plant, Plainfield, N. J., and Mack Bros. works, Allentown, Pa.

20—Formal announcement made that United States Steel Corporation will cancel the Great Northern ore lease and reduce freight rates for handling ore from the mines to a flat rate of 60 cents.

21—Additional steel companies abandon policy of quoting on a Pittsburgh basis and this practice largely responsible for weak condition of finished market.

23—Concessions of another $1 a ton offered on wire products, new price, $1.60, Pittsburgh, wire nails; $1.40, Pittsburgh, plain wire. Steel bars sold by some mills as low as 1.05c, Pittsburgh.

24—Robert Mather, chairman of the board Westinghouse Electric & Mfg. Co., died at New York.

25—Shenango Valley Furnace Co. sells round tonnage malleable pig iron $12.50, valley, reduction of 25 cents a ton under previous sale.

26—United States government files suit in United States circuit court, Trenton, N. J., to dissolve United States Steel Corporation; bill alleges Steel Corporation is an illegal combination in restraint of trade forbidden by the Sherman anti-trust law of July 2, 1890; bill names as defendents 37 companies, mostly subsidiaries of the Steel Corporation, five persons as trustees and 18 others as officers and directors. Special meeting of American Iron and Steel Institute, New York City, voted to increase number of directors from 15 to 21.

27—Independent steel companies of the Mahoning valley district inaugurate movement for more equitable railroad freight charges on raw material.

28—Interstate commerce commission suspends until Feb. 19, cancellation of the commodity tariffs on iron and steel commodities by rail carriers operating from Pittsburgh, Buffalo and other eastern points to western destinations, particularly points in Illinois, Iowa and Missouri.

30—Norfolk & Western railroad sends out first definite inquiry for 1912 steel rails. Two hundred ton lots Bessemer pig iron sold at Pittsburgh at new low price of $14.25, valley.

31—Canadian Pacific railroad orders 1,000 tons of boiler tubes from the National Tube Co. United States Steel Corporation reports good increase in business on all lines except rails since the filing of the government suit.

November

1—Bessemer pig iron average October announced as $14.53, valley, lowest since August, 1905. Basic average was $12.51, valley, lowest in years. Leading interest reports mill orders for steel bars in October as being heavier than for any single month since April, 1910.

2—American Bridge Co. receives contract for fabrication and erection of steel work of main structure and part of approaches for Hell Gate bridge, New York, involving 36,000 tons of steel, leaving 30.000 tons yet to be placed.

3—Selling of steel bars at 1.05c, Pittsburgh, and plates at 1.10c, Pittsburgh, more general. New York Central places order for 7,000 box cars.

4—Price wire products reduced $1, wire nails to $1.55, Pittsburgh, plain wire to $1.35; wire rods down $1 to $25, and cut nails down $1 a ton to $1.50.

6—Norfolk & Western railroad places order with a Pittsburgh steel company for 8,000 kegs of railroad spikes at $1.40, Pittsburgh, a reduction of $1 a ton. Pipe manufacturers issue a new list of discounts on oil country goods, showing an average reduction of 5 per cent.

7—Norfolk & Western railroad places first contract for 1912 steel rails; other roads follow with orders aggregating 150,000 tons.

8—Price of steel hoops reduced $1 a ton to 1.30c, Pittsburgh. Several large furnace interests send out formal inquiries for 1912 furnace coke.

9—Union Steel Casting Co., Pittsburgh, completes new foundry at a cost of $700,000 including real estate. Nineteenth annual report Colorado Fuel & Iron Co. for year ending June 30, shows gross earnings $22,934,685, decrease of 3 per cent compared with the previous year.

10—Price of 50 per cent ferro-silicon is advanced $8 a ton to $66, Pittsburgh. A Pittsburgh mill sells 10,000 tons of plates at 1.05c, Pittsburgh, and small lots for western shipment at 1c, Pittsburgh.

11—John McMurdie Warner, founder of Pittsburgh and Philadelphia branch houses of Rogers, Brown & Co., died at Overbrook, Pa. Big increase noted in tin plate bookings for new year. Estimated 60 per cent of large buyers are under cover.

13—Corrigan, McKinney & Co. announce plans for eight open-hearth furnaces at Cleveland. New York Central increases its equipment purchases to cover 17,400 freight cars and 120 locomotives.

14—Recent car buying responsible for more than 80,000 tons of plates being contracted for in the Pittsburgh territory.

15—American Steel Foundries buys 12,000 to 15,000 tons basic pig iron for Alliance, O., plant, at about $12.15, valley, and 10,000 tons for East St. Louis and Granite City at less than $15, delivered, for first half shipment.

16—The Bethlehem Steel Co. enters market as active and permanent seller of merchant pig iron.

17—Youngstown Sheet & Tube Co. awards contract for blooming mill equipment to the William Tod Co., Youngstown, and contract to Mesta Machine Co. for blooming mill engine.

18—Pittsburgh mill sells open-hearth billets at $19 and sheet bars at $20, Pittsburgh, a reduction of $1 a ton.

20—Additional contracts for freight cars are placed, bringing total for first 20 days of November up to 40,000 cars.

21—Pittsburgh Steamship Co. shipped its last cargo of ore from Lake Superior. Iron and steel manufacturers and railroad officials hold joint meeting in New York to discuss the request of the former for lower freight rates on raw material.

22—American Sheet & Tin Plate Co. starts 23 additional sheet mills. Quotation of $3.40, Pittsburgh, on tin plate for 1912 shipment shaded by some mills.

23—Republic Iron & Steel Co. makes contract with Ohio Iron & Steel Co., for 25,000 tons of Bessemer pig iron, giving iron ore in exchange.

24—Canadian Pacific railroad places orders for 2,000 cars with domestic builders.

25—Cambria Steel Co. withdraws low quotations on steel bars, advising trade of minimum quotation of 1.10c, Pittsburgh, for prompt shipment.

27—Bourne-Fuller Co., Cleveland, announces it will take over the Upson Nut Co. properties in Ohio and Connecticut, Jan. 1.

28—Pennsylvania railroad engineers meet in Pittsburgh and discuss plans and specifications for a tremendous increase in capacity of freight cars to be built for this road.

29—It is estimated that total sales of Southern pig iron during the past few weeks aggregate 300,000 tons. Some of the iron was sold at $9.75, Birmingham, for No. 2, the lowest price on southern iron since 1904. Sales of basic iron in Pittsburgh and Ohio territory for 1912 delivery aggregate 100,000 tons.

December

1—Announcement made by the Pittsburgh Steel Co., Pittsburgh, that it will build two blast furnaces and four additional open-hearth steel furnaces at Monessen, Pa.

2—Production of coke and anthracite pig iron in November amounted to 1,995,265 tons, decrease 96,796 tons, as compared with October. Shipments of iron ore in November aggregated 2,523,253 tons, making total movement for the year 32,130,411 tons, decrease 10,489,790 tons compared with 1910.

4—Jones & Laughlin Steel Co. enters market for 25,000 to 40,000 tons of basic pig iron for delivery at Aliquippa, Pa.

5—Price of prompt furnace coke advanced 5 cents to $1.55, ovens.

6—Republic Iron & Steel Co. starts new 90-inch plate mill at Lansingville, O., with capacity of 5,000 tons a month.

7—Finished steel mills make determined effort to advance quotations at least $1 a ton.

8—Carnegie Steel Co. makes new high production record at its 24-open-hearth furnace plant, Homestead, Pa., when production for 24 hours amounted to 3,961 tons, compared with 3,717 tons, the previous high record.

9—The railroads announce they will not grant lower freight rates on raw materials demanded by iron and steel manufacturers of Mahoning and Shenango valleys.

11—The leading interest and independent manufacturers advance prices on wire products $1 a ton, making nails $1.55, Pittsburgh, and plain wire $1.35, Pittsburgh.

12—Jones & Laughlin Steel Co. closes for 30,000 tons of basic pig iron at $12.10, valley, about 20,000 tons of this amount being taken in exchange for steel. Prices of sheets advanced $1 to $2 a ton, making quotations 1.40c, for blue annealed No. 10 gage; 1.90c for black No. 28 gage and 2.90c, for galvanized No. 28 gage, f. o. b. Pittsburgh.

13—Pennsylvania Railroad Co. increases its inquiry to cover 17,000 freight cars. Steel bars are advanced another $1 a ton to 1.15c, Pittsburgh.

14—Prompt furnace coke is sold at $1.50, ovens, the high mark so far this year. United States Steel Corporation bookings since Dec. 1, have exceeded 50,000 tons a day.

15—The railroads realize higher prices on monthly offerings of old material. Quotation of $38.50, seaboard, on ferro-manganese withdrawn.

16—Manufacturers of steel products are gradually getting back to policy of quoting on a Pittsburgh basis instead of f. o. b. mill.

18—Action of steel manufacturers in quoting higher prices does not check flow of orders and specifications continue to come in at a very satisfactory rate.

19—Youngstown Sheet & Tube Co. buys 25,000 tons of Bessemer pig iron from the Ohio Iron & Steel Co. at $14.25, valley, for January and February shipment. New high price on prompt furnace coke for the year established by sale of 1,000 tons at $1.65, ovens.

20—All sellers of ferro-manganese advance prices $2.50 a ton, the market now being quotable at $41, seaboard, for all delivery.

21—Specifications against contracts for finished steel this month exceed those of any corresponding period in 1911.

22—L. S. Starret Co., Athol, Mass., increased capital stock to $3,500,000.

23—Atikokan Iron Co., Port Arthur, Ont., announces plans for doubling capacity of its furnace plant and installation of by-product coke ovens. Arrangements made to lease blast furnaces of Warwick Iron & Steel Co., Pottstown, Pa., to Eastern Steel Co. for period of 99 years.

25—Steel mills close for Christmas holiday.

26—On account of big demand for steel products, practically all mills resume operation, instead of remaining idle for ten days as originally planned. Another advance of 50 cents a ton announced on crude steel. An eastern steel company buys 1,500 tons basic pig iron, second quarter shipment, at $12.45, valley.

27—Cleveland furnace interest buys 4,000 tons furnace coke, prompt shipment, at $1.80, ovens.

28—Sheet and tin mill operations increased to 75 per cent of total capacity and arrangements made to operate 90 per cent of serviceable mills early in the new year.

29—Rail orders placed during last quarter of the year aggregate 300,000 tons for 1912 delivery. Large awards still pending.

30—Year closes with mill operations at highest point during the twelve months, and with prospects bright for extremely heavy production in January. Higher prices on steel products recently announced are being maintained.

LOCOMOTIVE INDUSTRY

In 1909 Decreased in Volume Compared With 1904.

A statement of the general results of the thirteenth census relative to establishments engaged in the manufacture of locomotives, except those made by railroad companies, was made Dec. 22 by Director Durand, of the bureau of the census, department of commerce and labor. The report, which gives the general figures for 1904 and 1909, is as follows:

There were 16 establishments engaged in this industry in 1909 and 15 in 1904, an increase of 7 per cent.

The capital invested, as reported in 1909, was $52,060,000, a gain of $13,639,000, or 35 per cent over $38,421,000 in 1904. The average capital per establishment was approximately $3,254,000 in 1909 and $2,561,000 in 1904.

The value of products was $31,582,000 in 1909 and $59,552,000 in 1904, a decrease of $27,970,000, or 47 per cent. The average per establishment was approximately $1,974,000 in 1909 and $3,970,000 in 1904.

The value added by manufacture was $16,522,000 in 1909 and $31,849,000 in 1904, a decrease of $15,327,000, or 48 per cent. This item formed 52 per cent of the total value of products in 1909 and 53 per cent in 1904.

The miscellaneous expenses amounted to $2,117,000 in 1909 and $2,416,000 in 1904, a decrease of $299,000, or 12 per cent.

The number of salaried officials and clerks was 2,029 in 1909 and 1,164 in 1904, an increase of 74 per cent; their salaries increased from $1,675,000 in 1904 to $2,297,000 in 1909, or 37 per cent.

The average number of wage earners employed during the year was 14,009 in 1909 and 24,806 in 1904, a decrease of 40 per cent; their wages decreased from $15,798,000 in 1904 to $8,914,000 in 1909, or 44 per cent.

LITIGATE QUESTION

To Determine Ownership of Ore Under Lakes and Rivers.

Does the state in its sovereign capacity own the iron ore under the lakes and rivers, or is that ownership vested in the possessors of the riparian rights? That is the important question at issue in litigation in Minnesota, and mining men in the Lake Superior country in general are greatly interested in the outcome. Directly concerned in the pending suit is a deposit of ore containing less than 100,000 tons. It underlies Longyear lake, on the Mesabi range. The ultimate adjudication by the courts will affect the title to various known and probable deposits of great value in the aggregate. An ore body under Lake Embarrass, in the Aurora district, is alone estimated to contain more than 20,000,000 tons. The state is the plaintiff in the present suit; the defendants are the owners of shore rights, who have leased their property to a mining company.

The state takes the position that the riparian title extends only to the high-water mark, with certain rights appurtenant to the upland which do not include the right to mine in or otherwise encroach upon the bottom of the lake. "The case at bar is merely in the nature of a test case," asserts the brief of the attorney general. "There may be other lakes or rivers in this state similarly conditioned, the bottoms of which may contain millions of tons of iron ore."

Reorganize Otis Steel Co.

The Otis Steel Co., of Cleveland, will be reorganized under the laws of Ohio, a new company being formed to take over the old company, which has been operating under a charter from Great Britain. The company's headquarters have hitherto been in London, and its capital is mainly English.

The Youngstown Sheet & Tube Co. has awarded a contract to the Variety Iron Works, Cleveland, O., for 600 charging boxes for the new open-hearth steel plant for which contracts were awarded recently.

A. P. Mount & Son, architects, Corry, Pa., have prepared plans for a two-story brick and steel armory to be erected at Bradford, Pa. at a cost of $25,000.

Periodical Swings of the Iron Trade Defined

Parallelisms of the Booms and Depressions in the Country's Greatest Industry Covering 20-Year Periods from 1867

By B E V Luty

THE editor of THE IRON TRADE REVIEW gave the writer the following assignment: "Is there a definite periodicity in the iron trade?" Now we all know that there is some kind of periodicity, but the editor demanded something definite, put in a form that would be interesting and useful. Periodicity is a fundamental principle in nature, whether the swings if the pendulum or the recurrence of pain. In these two cases there is more than a general principle; there are laws, and on account of there being laws it occurs that the knowledge of the periodicity can be made useful. With the pendulum, clocks are made, for the law is that the swings, within a limited arc, are of absolutely equal duration. With pain, the physician uses his knowledge of the law that if the interval is shortening a more acute stage is being approached; if the time is lengthening the danger is being left behind.

Everyone admits that there is some sort of periodicity in business, for if we say that since prices have gone up they must go down, or if we say that since prices have gone down they must go up, we admit our belief in some sort of periodicity. Is there enough regularity to make the study worth while?

The writer thinks there is, but not through any belief that the study can furnish a basis or guide that we should follow in preference to other leads. There is a much more practical, a much more immediate reason, why business men should study the periodicity, and that reason is one which is not usually considered. It is natural for us to make up our minds by reason of the things we see in the present, but we are likely to misinterpret them through not taking a long range view of the trends. The study of the periodicity enables us to take a long range view. There may be some who will not admit that the study of periodicity affords any help in gaging the future, but all reasonable men ought to admit that the study will help one not to be misled by the trends of the present. The study shows how quickly such trends reverse themselves, and furnishes a positive help by guarding us from the errors of a close range view.

There may be a periodicity in the swings of the iron trade without a knowledge of the periodicity being useful. The law or principle may be too complicated. The man who loves figures for their own sake, the man who wants to stay with his figures rather than get away from them to general results and conclusions, can find laws and principles in almost any set of tables which are of no earthly use, and the more complicated the laws the more such a statistician is pleased. If there is no simple thing, no fact that stares one in the face and grasps the attention almost against one's will, there is nothing in it worth while.

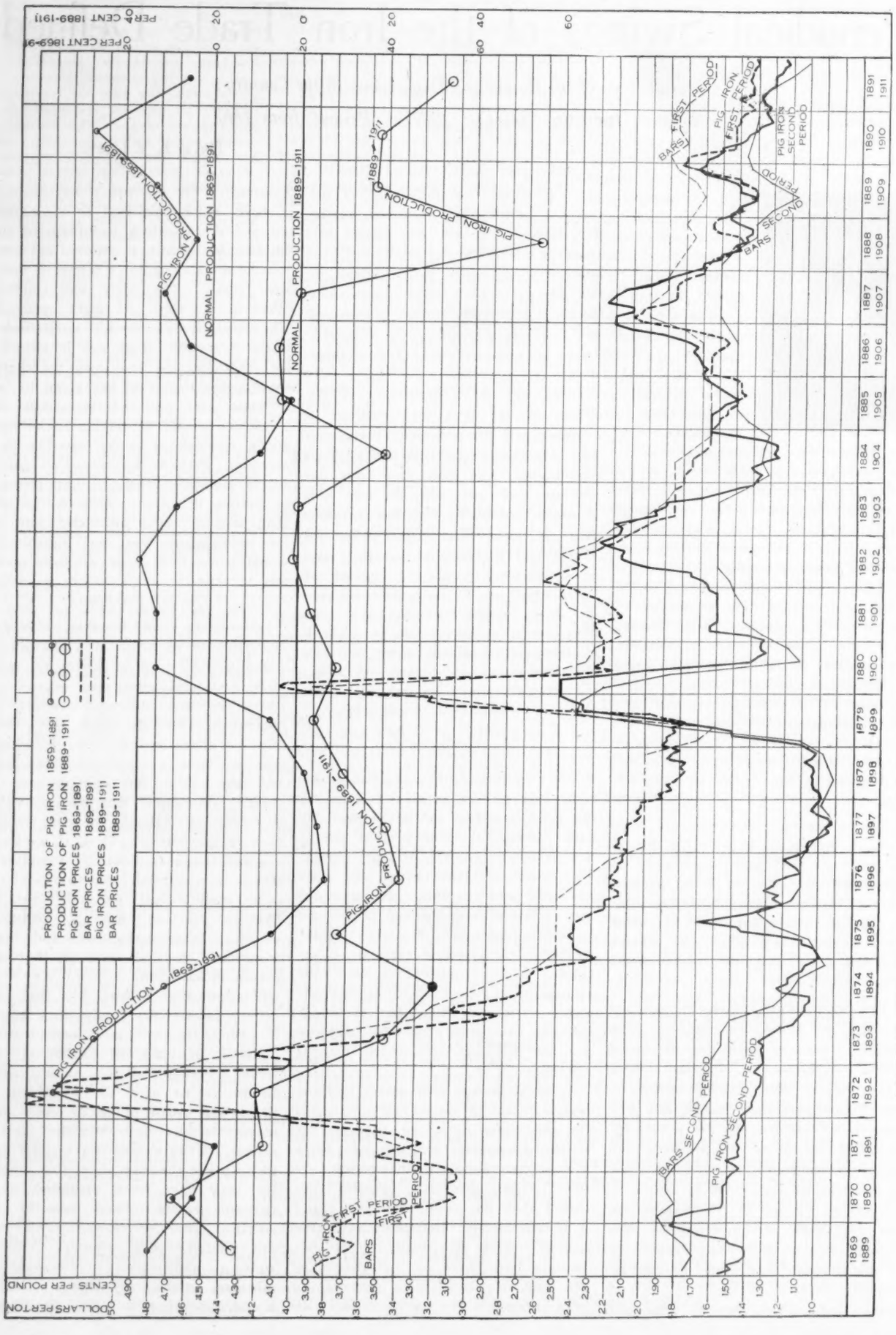
A Startling Fact.

There is such a thing in this study. It is that over a period of 20 years the great majority of the swings that have occurred are duplicates of swings that occurred precisely 20 years earlier. The booms, the depressions, the price advances and declines, the increases and decreases in production, have nearly always duplicated themselves at intervals of 20 years. If this is an accident, it is a miraculous one. Of course there have been exceptions, some of them glaring, but the coincidences are greatly in the majority and that is enough to show that *there is something in it.*

A great many men have probably reasoned that it would be miraculous for this thing to be an accident, but equally miraculous for there to be a law which would produce such results. Hence they have probably concluded that the thing does not exist; it is a trick of the statisticians. We can all feel for those men, for the statisticians have bored us, and twisted us and fooled us until it is not easy to have patience with them as a class. In December, 1906, the writer was handed a chart, which purported to show the ups and downs which had occurred in business for almost a century, and then ran the thing along for a couple of decades ahead. The chart was entitled "Periods in which to make money." The writer put it in his scrap book, where it is now. That was in December, 1906, and the first thing the chart showed was that 1908 was going to be a boom year, one of the years in which one should unload his stocks and goods, accumulated in the preceding depression. Perhaps the subject is painful to some who used the chart instead of putting it in a scrap book, so we shall pass on. It is mentioned only as an instance of how the statisticians would often fool us if we took them up.

Law of Periodicity

Let us take issue, however, with the idea that the existence of a law which would produce such a periodicity, such a recurrence of event after event in a 20-year or any other cycle, would be miraculous. We all admit that there must be action and reaction, that what goes up must come down, that there are *after effects* and all that sort of thing. We admit that nature tends to restore the balance, to bring things back to the normal. Then, if we have a great boom (a boom is something which is abnormal, something which is too good to last) we shall naturally have a reaction, into a condition which is abnormally bad, and then from that we shall have another reaction upward, and so on. Anybody will admit that a thing like that can occur; indeed, everybody does admit it. Well, that will go a considerable distance, at least, in explaining the thing. Perhaps all we should need would be to give the pendulum a great big shove every 20 years and leave this universally admitted law to attend to the details. We shall not go into the theories about that shove, for they have been exploited to a tiresome extent. There was the old so-called *sunspot* theory, which was not fundamentally visionary, because sunspots and cycles in the weather, affecting crops, very likely do have a common origin, but after the theory



DIAGRAM, SHOWING A COMPARISON OF THE PRODUCTION AND PRICES OF PIG IRON AND THE PRICES OF MERCHANT BARS OVER TWO CONTIGUOUS 20-YEAR PERIODS

was broached the weather cycles and the business cycles got out of tune. Then there is the theory of *the life of a business generation*, perhaps by way of a new crop of business men who do not know the lessons of the past and bring on a boom which becomes top-heavy, and there may be something in that.

But what of that? It would be a miracle for all these things to come by chance, but it would be no miracle for one solitary element, the length of the period, to furnish the chance coincidence that it corresponds with two decades, instead of with 19 years, or 23 years, and having that one element, the 20 years, fixed, for the details to fall in according to the general principle of business swinging back and forth. Perhaps next time it will not be 20 years. Let us leave that for our grandchildren to develop. Enough facts will accumulate for them to be able to tell whether or not there is something in the 20-year story. Meanwhile let us study the details, and since the details 20 years apart do largely coincide, let us simply plot the past two 20-year periods, one on top of the other, so that we shall have often two facts instead of one when we see an upward or downward swing.

This is not a *statistical* article, but it must have its basis of facts, and those facts can be nothing but the record of tonnages produced and consumed, and prices paid and received for those tonnages. The statistical work done to furnish a basis for the article has been to select, arrange and condense so that the maximum of fact could be presented with a minimum of *statistics*. Pig iron is our fundamental material, but as we must cover a period of a little more than 40 years, we cannot use one grade of iron, for processes have changed. Basic open-hearth steel did not become prominent until the late nineties. Bessemer steel came into great vogue in the seventies and eighties, but chiefly as a rail material. The fundamental material in the earlier portion of our period was gray forge pig iron, used in making wrought iron, and its price fluctuations cover the entire ground for that period. In the nineties Bessemer pig iron was the fundamental material, used extensively and bought and sold freely. Lately, Bessemer pig iron as a great market commodity has given place to basic pig iron. For a continuous record we have taken gray forge pig iron alone from 1869 through 1890. For the next three years, when soft steel was supplanting wrought iron for so many products, we gradually merged forge pig into Bessemer, mixing them each month through the three years with less and less forge and more and more Bessemer, and swinging exclusively into Bessemer for 1894 and many succeeding years. All these prices were taken at Pittsburgh, Towards the close of 1905 and in the early part of 1906, a boom in prices occurred so striking that it was easy to slip in a few months from Bessemer pig iron, Pittsburgh, to basic pig iron, valley, without distorting the curve of prices for this purpose. Thus we have a continuous record of *the price of pig iron* reflecting all along the ups and downs in the market as a whole.

To represent finished product nothing could be better than merchant bars, more widely used, both long ago and at present, than any other distinct finished product. As steel supplanted iron the prices almost coincided, and thus we have taken iron bars through 1896 and steel bars from 1897 to the present, giving a fair representation of the swings in finished product.

To chart production in an illuminating way furnished a problem. It is useless to plat tonnages of pig iron

Table I.

REPRESENTATIVE PIG IRON PRICES.

	Gray Forge Pig, Pittsburgh													
	1869.	1870	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.
January	$38.25	$36.75	$30.75	$40.00	$40.00	$31.00	$22.75	$22.25	$21.00	$19.00	$19.00	$39.50	$22.50	$25.00
February	38.50	36.25	31.50	41.75	40.00	30.75	23.50	22.25	21.75	19.25	18.75	41.00	22.75	26.00
March	38.50	36.25	33.00	48.00	42.00	29.00	24.00	21.50	21.50	18.50	18.75	40.50	22.75	25.50
April	38.00	33.75	35.00	55.00	41.50	27.75	24.00	21.50	21.50	18.75	18.25	35.00	23.00	25.00
May	37.25	31.75	34.50	54.00	39.25	27.00	24.00	22.00	21.00	18.25	15.50	25.00	23.00	24.00
June	37.00	31.00	33.50	55.00	35.50	27.00	24.25	21.50	21.00	18.00	17.75	22.00	21.50	24.00
July	36.50	30.50	32.50	50.50	35.25	27.00	24.00	22.00	21.00	17.75	18.75	23.00	21.75	24.00
August	36.25	31.00	33.50	53.50	34.00	26.50	24.00	21.75	20.50	18.00	19.75	22.50	22.00	24.00
September	37.00	31.00	34.00	52.50	33.75	26.50	24.00	21.50	20.25	17.75	26.75	22.50	22.50	23.00
October	37.50	31.00	35.50	49.50	31.75	26.25	23.50	21.50	20.50	18.75	31.50	22.50	23.00	22.50
November	37.50	30.50	38.75	49.00	29.25	24.75	23.00	21.25	20.25	18.50	32.50	22.50	23.75	21.75
December	37.50	30.50	40.00	40.50	28.25	23.25	22.25	21.25	20.25	18.00	32.25	22.50	24.25	21.50

	Gray Forge Pig, Pittsburgh								Bessemer and Forge.			Bessemer pig, Pittsburgh.		
	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.
January	$21.00	$18.00	$16.25	$16.50	$20.50	$17.00	$15.50	$18.00	$14.30	$14.25	$13.05	$10.66	$ 9.93	$12.00
February	20.50	18.00	16.00	16.50	21.00	16.75	14.75	18.00	14.60	14.00	13.00	10.61	10.07	12.63
March	20.00	17.75	16.00	16.50	20.50	16.50	15.00	17.00	15.10	13.60	13.10	10.40	10.19	12.32
April	19.50	17.50	15.50	16.50	20.25	15.65	14.25	15.35	14.35	13.65	13.15	10.39	10.68	13.10
May	18.50	17.50	15.50	16.50	19.00	15.50	14.00	15.25	14.40	13.50	13.00	12.00	11.64	12.64
June	18.50	17.50	15.00	16.25	18.50	15.25	14.00	15.25	14.30	13.40	13.30	12.31	12.33	12.35
July	18.50	17.00	15.00	15.75	18.50	14.75	14.15	15.25	14.50	13.40	12.90	11.70	14.38	11.88
August	18.50	16.75	14.50	15.50	18.50	15.00	14.90	15.25	14.40	13.20	12.50	11.71	14.63	10.98
September	18.50	16.50	14.75	15.75	18.50	16.25	15.00	15.25	14.40	13.20	12.10	11.29	17.02	11.52
October	18.50	16.50	14.75	16.50	18.25	16.50	16.60	15.00	14.25	13.15	11.35	10.89	15.45	11.62
November	18.50	16.50	14.75	17.75	17.75	16.50	17.25	15.00	14.00	13.50	11.15	10.61	13.72	12.05
December	18.00	16.50	15.25	19.00	17.00	16.25	18.25	14.75	14.10	13.30	10.85	10.20	12.67	11.24

	Bessemer Pig, Pittsburgh								Basic Pig, Valley					
	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.
January	$10.56	$ 9.87	$11.00	$24.90	$13.25	$16.60	$21.65	$13.76	$16.41	$17.00	$22.00	$17.10	$15.50	$16.87	$13.29
February	10.60	10.05	12.40	24.90	14.20	16.85	21.50	13.49	16.35	16.70	22.00	17.00	15.19	16.31	13.60
March	10.52	10.39	15.05	24.90	16.40	17.50	21.91	13.85	16.35	17.00	21.00	16.00	14.94	15.00	13.75
April	9.82	10.41	15.15	24.90	16.35	17.60	20.56	14.15	16.36	17.15	21.00	16.00	14.15	15.94	13.75
May	9.32	10.30	16.45	22.00	16.00	20.00	19.56	13.37	15.97	17.25	22.50	14.83	14.12	15.04	13.40
June	9.56	10.34	18.30	20.00	16.00	21.00	19.64	12.45	15.70	17.50	22.25	15.25	14.94	14.70	13.06
July	9.25	10.25	19.88	17.00	16.00	21.50	19.06	12.73	14.83	17.25	21.94	14.49	15.00	14.50	13.00
August	9.33	10.35	22.00	14.00	16.00	21.50	18.85	12.66	15.25	17.75	21.44	14.62	15.27	14.02	13.00
September	10.09	10.78	23.60	13.55	16.00	21.35	17.06	12.64	15.70	18.37	20.07	14.27	15.90	13.83	12.67
October	10.45	10.36	23.60	13.12	16.00	22.25	15.90	13.41	16.10	19.31	19.69	14.25	16.94	13.15	12.51
November	10.23	10.15	24.35	13.45	16.00	22.75	14.93	14.98	16.50	21.00	18.75	14.93	17.49	13.36	12.23
December	10.01	10.58	24.95	13.40	16.50	21.95	14.05	16.48	16.90	22.00	18.00	15.50	17.00	13.47	12.40

production over a period of 40 years, for the tonnage has been multiplied by 15 during that time, and the curve, placed on the same diagram with prices, would be utterly useless. We require that the fluctuations in output when the tonnage was one-half, one-quarter, one-eighth as much as recently, to be as distinct and broad as the present fluctuations. Hence we plot the percentage departures from normal. In 1867 and in 1907 all previous tonnage records were broken. We compare those years, the first with 1,305,023 gross tons of pig iron and the second with 25,781,361 tons produced, and find that if in each year after 1867 there had been an increase, over its preceding year, of 7.74 per cent, the 1907 tonnage would have been produced. It is compound interest computed annually at the rate of 7.74 per cent. With this steady rate of gain, each year would have shown a certain tonnage, and that certain tonnage divided into the tonnage the record shows actually was produced shows how many per cent the actual production ran above or below the normal or expected production. Those percentages are shown in Table II.

Our selection of 1907 as a normal year makes it that the percentages of the four following and of many of the immediately preceding years are adverse. To avoid having many years appear as poor years it would have been necessary to consider 1907 as an abnormally good year. In its day it was not considered normally good, particularly when it is considered that in the two closing months production was much below the capacity. The point is of little consequence, for what we wish to consider is chiefly the variations from a group of years to a contiguous group of years, and it matters relatively little how the signs run, since on the accompanying diagrams the absolute trends are shown, whether they chance to be above or below the assumed normal. We readily can see which years ran ahead and which ran behind their fellows, and as the plus and minus years are more uniformly mixed in the early than in the late years, it would appear that in the late years production has not been gaining altogether as rapidly, in point of percentage, as in the earlier years.

Instead of plotting the data of the period from 1869 to the present continuously, we have doubled up, so as to place the years 20 years apart at the same points in the accompanying diagram, and thus they may readily be compared. Furthermore, in order not to have nothing but the abrupt ending for 1891, which stands with 1911 in the diagram, we have repeated 1889, 1890 and 1891 at the beginning of the diagram, setting with those years the three years 20 years earlier. Thus for a given element in the diagram, like the price of pig iron, we have one line which shows prices from 1869 to 1891, and then we have another line which shows prices from 1889 to 1911. The pig iron prices are given by months, the bar prices by quarters (averages for the quarter) and the production statistics are simply by years. There are no closer data for the earlier years. It may be of interest to observe that the pig iron prices for the first 12 years of the period are an old compilation, published in 1881, and drawn from the books of a prominent pig iron brokerage firm in Pittsburgh. They are the averages of actual sales. In those days nearly all the iron in the district was handled by brokerage houses.

Table II.

Pig iron production; per cent above or below normal.

1869	+12	1891	+ 6
1870	+ 2	1892	+ 8
1871	— 3	1893	—21
1872	+34	1894	—32
1873	+25	1895	—10
1874	+ 9	1896	—24
1875	—15	1897	—21
1876	—27	1898	—11
1877	—25	1899	— 4
1878	—22	1900	— 9
1879	—14	1901	— 3
1880	+12	1902	— 1
1881	+12	1903	0
1882	+16	1904	—20
1883	+ 8	1905	+ 4
1884	—11	1906	+ 5
1885	—18	1907	0
1886	+ 5	1908	—55
1887	+11	1909	—17
1888	+ 4	1910	—18
1889	+13	1911	—34
1890	+27		

In order that the lines representing production in the two periods should not become inextricably tangled, they are figured from separate base lines, the upper base line for 1869 to 1891 and the lower for 1889 to 1911. As the lines pass above and below their base lines, the showing is of the production running a percentage above or below the normal, figured as stated upon the principle that production should have increased in uniform geometric ratio from 1867 to 1907.

Coincidence of Production

Many coincidences in the kinks of the two lines of production are at once observed. In 1876-7 and 1896-7 production was low. In 1879-93 and 1899-1903 it was high. Then there were sharp decreases, but not coincident, one being in 1885, but the other in 1904, instead of 1905. In each case a sharp gain followed, and then in 1888 and 1908 production was low. In 1908, the slump was much greater than in 1888, and no one is likely to deny that the particular severity of the slump was due in part to the artificial maintenance of prices in 1908.

So much for the coincidences. Now for the divergences. If it is suggested that 1870 production was below 1869, while 1890 production was ahead of 1889, we confess that we are expecting a great deal by way of similarity. A striking difference is that in 1894 we had a special slump in production, which did not occur in 1874, while in 1895 we had a special rise, which did not occur in 1875. Otherwise the big troughs from 1872 to 1880 and from 1892 to 1899 are striking.

Prices of Bars and Pig Iron

Pig iron prices are represented by heavy lines in the accompanying diagram, broken for the first period, solid for the second period, while bar prices are represented by light lines, broken for the first period, solid for the second. Thus the first period is represented by broken and the second by solid lines, pig iron being taken as the governing element, with bars thrown in by way of confirmation and shown light. Throughout the two periods bars and pig iron kept close together, illustrating the sufficiency of the figures to represent conditions as to prices in general. Departures occurred in 1902 and 1906-7, when pig iron advanced much more than bars. Bar prices were restrained from advancing unduly, while in pig iron there was an open market. The scale of the diagram is such that $10 for pig iron coincides with 1 cent for bars, and so on. Thus if bars sell at $20 a net ton and pig iron at $10 a gross ton, or bars at $40 a net ton and pig iron at $20 a gross ton, the points coincide. In general they do run very close together.

In 1872, a boom in prices culminated, there being no counterpart in 1892. That boom was in large part due to the activities following the close of the war, and, of course, no one requires that wars also should occur every 20 years. Prices declined, reaching low points in 1878-9 and 1897-8, respectively, 19 years apart instead of 20. Then came the

spectacular events, a tremendous boom in 1879 and another in 1899. The 1879 boom ran two months into 1880, while the 1899 boom ran a trifle farther into 1900 in pig iron, but not as far in bars. In 1880 and 1900 there were slumps, in 1881-2 and 1901-2 recoveries and in 1883-4 and 1903-4 slumps. Then, in the earlier period the slump ran into the following year, 1885, but in the later period recovery started in 1905. In the early period the good years were 1886-7 and in the late period, 1905-6-7. Both closed at the same time, the late portion of 1887 and 1907. It is interesting to observe that in 1906-7 pig iron was materially higher than in 1886-7, while in general the prices in the second period were lower than those in the first period.

The General Trends

We have been proceeding from the particular to the general, but have sought to be not very tiresome and, therefore, have passed over much that could be said in support of the parallelisms. A general view of the diagram will illustrate strikingly the harmony. If the details are not easy to scrutinize, it is because the lines show such a great tendency to run together, which in itself illustrates the very point at issue.

Leaving now the parallelism in the 20-year periods, one readily observes three great periods of price advance and decline, culminating, in the late period, in 1899, 1902 and 1906-7. These three great advances stand out strikingly in the history of over 20 years, yet they are all three comprised in the brief space of nine years. The first was the sharpest and shortest, and if there is no lesson in that there is no lesson in anything. Recovery, on the other hand, was equally prompt. A striking feature of all the movements is the individual symmetry. Prices declined neither more nor less rapidly than they advanced. If they advanced rapidly, they declined rapidly, and *vice versa*.

Where Are We Now?

Not a few people regard the 20-year cycle as a threat at this time. They say we had a severe industrial depression from 1893-8; are you going to predict another from 1913 to 1918? Not at all. Probably the general recollection is that the depression began in 1893, the year of the great bank panic. That impression may be correct, as to general business, but as to the iron business the story is different, and it is well to get it now from these data. The depression in the iron industry really began to be felt in 1890, a year in which Bessemer pig iron declined $7 a ton and large stocks accumulated. So early did the depression in iron begin that a sharp, though short, revival occurred in 1895. Lower prices occurred in 1897-8, but the situation had been liquidated, and low prices were made largely because costs were low. Profits were greater than in earlier years.

Instead of a scrutiny along this line, or acceptance of any cyclical theory, suggesting that there is yet to come for the iron industry a depression and a long one, the lesson rather is that we are in the depression, and have been in it for some time. It is not: "Never mind this; wait until you see the worst!" Rather it is that the readjustment has started, and is proceeding apace. It may be long before startling recovery in prices occurs, before advances like those of 1899, 1902 and 1905-6-7 are repeated, but the iron industry is not looking for such things. Already, in the past four years, our tonnage outputs appear to have been lower than there was reason to expect, and if so, the recovery is the nearer.

A final point should be mentioned. The depression of the nineties in general business was severe because our monetary standard appeared in danger. No similar danger now confronts us. Steps are being taken to correct what is wrong, and no such thing occurred the other time. Instead there was the absurd silver purchase remedy which proved worse than the disease. Again, the depression of the nineties was severe upon the iron industry because the progress in manufacturing processes, the change from iron to steel, rendered useless a vast amount of plant. Iron mills were abandoned right and left. They were behind the times. Today no large part of existing equipment stands in similar jeopardy. The existing equipment is largely modern and does not need replacement with great loss of capital.

Table III.

MERCHANT BARS, PITTSBURGH

Base sizes: cents per pound: iron through 1896, steel thereafter; by quarters.

	First.	Second.	Third.	F'rth.
1869	3.50	3.50	3.50	3.50
1870	3.50	3.25	3.25	3.25
1871	3.25	3.25	3.50	3.50
1872	4.20	4.80	5.00	4.70
1873	4.50	4.00	3.75	3.30
1874	3.20	3.00	2.80	2.60
1875	2.50	2.50	2.50	2.50
1876	2.50	2.40	2.30	2.20
1877	2.00	2.00	2.00	2.00
1878	2.00	2.00	2.00	2.00
1879	1.70	1.60	2.50	3.10
1880	3.90	2.60	2.35	2.30
1881	2.15	2.25	2.45	2.50
1882	2.45	2.35	2.50	2.30
1883	2.20	2.00	1.90	1.85
1884	1.85	1.85	1.75	1.65
1885	1.65	1.65	1.65	1.65
1886	1.70	1.70	1.70	1.80
1887	2.00	2.00	1.90	1.90
1889	1.75	1.70	1.75	1.85
1890	1.90	1.80	1.85	1.85
1891	1.80	1.70	1.65	1.65
1892	1.65	1.60	1.60	1.60
1893	1.60	1.55	1.55	1.50
1894	1.25	1.15	1.10	0.95
1895	1.00	1.05	1.25	1.35
1896	1.15	1.10	1.10	1.10
1897	1.05	0.98	0.92	0.99
1898	0.95	0.92	0.95	0.98
1898	0.95	0.92	0.95	0.98
1899	1.12	1.85	2.40	2.37
1900	2.25	1.87	1.12	1.18
1901	1.34	1.45	1.45	1.50
1902	1.53	1.60	1.60	1.60
1903	1.60	1.60	1.60	1.45
1904	1.31	1.35	1.34	1.31
1905	1.43	1.50	1.50	1.50
1906	1.50	1.50	1.50	1.55
1907	1.60	1.60	1.60	1.60
1908	1.60	1.53	1.40	1.40
1909	1.31	1.17	1.32	1.43
1910	1.46	1.44	1.42	1.40
1911	1.40	1.34	1.21	1.11

LEASE SECURED

By Canadian Syndicate For Ore Lands on Orinoco River.

The Canadian-Venezuela Ore Syndicate, with headquarters in Montreal, has, after much investigation, completed the lease of some ore properties on the south side of the Orinoco river, in Venezuela, the lease having been made directly with the Venezuelan government.

Those most actively interested in the operations in Canada are B. F. Pierson; his son, G. F. Pierson, and F. B. Jones. The concession upon which they are operating is the old Imataca property, about 80 miles from the mouth of the river. The ore is said to run over 50 per cent metallic contents and some of it has analyzed as high as 60 per cent.

The syndicate recently chartered the steamship Alabama and discharged a shipload of supplies and equipment from Philadelphia, and will follow this up with another load, which will enable the operators to commence work on an extensive scale.

As the ore lies right on the river bank, long hauls are unnecessary and there is plenty of water rights on the property. It is expected that the ocean freight to Philadelphia will be about $1.50 per ton.

Reduce Price of Sheet Zinc

A leading producer of sheet zinc has reduced the base price of that product from $8.25 to $8 per 100 pounds, delivered on board cars, La Salle, Ill., in 600-pound casks. The change took effect Dec. 26. Extra remains unchanged.

Pittsburgh Market Review

(Continued from page 5.)

about 60 per cent of capacity and by February, 1911, they increased to 64 per cent of capacity. March proved to be the best month in point of production, although the output for the first half of December exceeded that of the first 15 days in March, but production declined materially during the holiday season. The year opened with Bessemer and open-hearth billets quoted at $23, Pittsburgh or Youngstown, and while this price was quoted during the first five months of the year, there was more or less shading by some of the independent mills, particularly on open-hearth steel. On June 1, there was a general reduction to $21 on Bessemer and open-hearth billets, and to $22, Pittsburgh or Youngstown, for Bessemer and open-hearth sheet bars. Late in September, concessions of $1 a ton were offered on open-hearth billets and sheet bars and during the latter part of that month the lower prices on both billets and sheet bars became general. In November, Bessemer billets dropped to $19.50, Pittsburgh or Youngstown, and during the closing week of that month sales of both Bessemer and open-hearth billets were made at less than $19, Pittsburgh. On Dec. 1, the market ruled about $19 for billets, and $20 for sheet bars, these prices being advanced about 50 cents a ton about the middle of the month. In January, 1910, the monthly average price was $27.87, Pittsburgh, for Bessemer billets, and there was a gradual decline throughout the year, the average for December of that year being $22.80. During the third quarter of 1911, a number of the steel companies discontinued the practice of quoting f. o. b. Pittsburgh or Youngstown, and, by giving away part of their freight advantage, named delivered prices which, if figured back to a Pittsburgh base, were considerably under the prices quoted above.

An interesting feature in connection with this market is the fact that three large steel companies in the western Pennsylvania territory, which had not been manufactuurers of open-hearth steel, completed or started work on open-hearth plants, while one large independent steel company greatly increased its open-hearth steel capacity and another independent company authorized the building of four additional open-hearth furnaces. The Republic Iron & Steel Co. placed in service eight 60-ton open-hearth furnaces in the Youngstown district. The Pittsburgh Crucible Steel Co. is now building an open-hearth steel plant at Midland, Pa., and the Youngstown Sheet & Tube Co. in November awarded contracts for its open-hearth steel furnaces at Youngstown. In addition, the Jones & Laughlin Steel Co. completed four Talbot open-hearth steel furnaces at Aliquippa and the Pittsburgh Steel Co. authorized the construction of four additional open-hearth steel furnaces at Monessen, Pa., increasing its capacity to 12 open-hearth furnaces.

Merchant Bars

As was the case in other lines, prices of both iron and steel bars suffered during the year. The year opened with both steel bars and bar iron quoted at 1.40c, Pittsburgh. On steel bars 1.40c, Pittsburgh, continued as the general asking price until the latter part of May, when the Republic Iron & Steel Co. surprised the trade by announcing a reduction of $3 a ton to 1.25c, Pittsburgh. During the closing week of May other manufacturers took similar action, the new card becoming effective June 1. During the latter part of July, the market dropped $1 a ton, and about the middle of September a further concession of $1 a ton was offered, making the price 1.15c, Pittsburgh. A further weakness developed in October, when 1.10c, Pittsburgh, became general. In November, the market dropped to 1.05c, Pittsburgh, and on particularly desirable business some mills accepted orders as low as 1c, Pittsburgh, although this price was rather exceptional. Late in November, the Cambria Steel Co. advanced the price of steel bars $1 a ton and a few days later the Republic Iron & Steel Co. announced its minimum quotation as 1.10c, Pittsburgh. Similar action was taken by other mills. About a month later, there was another advance of $1 a ton by the principal makers. Bar iron dropped from 1.40c, Pittsburgh, in January, to 1.20c, Pittsburgh, early in November, and later advanced $1 a ton, the market level at the close of the year being about 1.25c, Pittsburgh. The principal addition to steel bar capacity during the year was the completion of the Republic Iron & Steel Co.'s new mill at Youngstown with a capacity of about 10,000 tons a month.

Plates

Aside from the heavy reduction in prices, which reached the lowest level in 10 years, the chief event in the plate market during the year was the extremely heavy buying of freight cars during the last quarter. In the month of November alone orders were placed for upward of 40,000 steel freight cars, of which the New York Central was the principal buyer, orders placed by this company aggregating 22,000 cars of various types. Car orders placed in November called for approximately 500,000 tons of plates, shapes, bars, castings and wheels. There was a temporary lull in car buying during December, but at the close of the year pending inquiries involved from 20,000 to 40,000 cars. During the early part of the year, car buying was extremely light. In July, orders aggregated 2,000 cars. About 6,000 cars were ordered in August and contracts were placed in September for 4,000 cars. The big spurt in car buying during the fourth quarter resulted in a general resumption at the principal car building plants and plate mills, and operations at the close of the year reached the highest point in two years. Early in February, the Cambria Steel Co. received an order for 17,000 tons of plates and shapes for boats to be built at the Great Lakes Engineering Works for the Shenango Steamship Co.

At the opening of the year, plates were quoted at 1.40c, Pittsburgh, and, while concessions were offered during the following five months, a general reduction was not announced until July 1, when there was a cut of $1 a ton to 1.35c, Pittsburgh. In August, the price dropped to 1.30c, Pittsburgh, and a further cut of $1 a ton was made in September. Early in October, the market dropped to 1.20c, Pittsburgh, and during the first week of November sales were made at 1.15c, Pittsburgh. About the middle of November, sales were made as low as 1.05c, Pittsburgh, but, on account of heavy car buying, the price gradually advanced to 1.15c, Pittsburgh, and at the close of the year some companies reported sales for immediate shipment at 1.20c, Pittsburgh.

Structural

During the first few months of 1911 and the fourth quarter of the year, heavy tonnage in structural steel was placed and reports for this branch of the trade made a better showing than in some of the other finished lines. An interesting feature in connection with the structural market during the year was the placing of some of the largest individual contracts in the history of the trade. These include the Hell Gate brdge, requiring in the neighborhood of 70,000 tons of steel and the Quebec bridge, revised specifications for which called for 65,000 tons of material, placed with domestic mills.

As was the case in 1910, new construction work was comparately light in the immediate Pittsburgh district and local mills and fabricating shops received the major portion of their tonnage from other sections of the country. The American Bridge Co. received contracts for buildings to house the open-hearth steel plants of the Youngstown Sheet & Tube Co., Youngstown, and the Pittsburgh Crucible Steel Co., Midland, Pa., involving about 6,000 tons each, these being among the largest contracts placed in the immediate Pittsburgh territory. During the year, estimates were prepared on a large amount of work in the western Pennsylvania field to be taken up in 1912. At the close of the year, practically all of the structural steel mills and fabricating shops were operating at greater capacity than at any time during the year. Price fluctuations on structural steel were similar to those on plates, while fabricating prices reached the lowest level in years. The year opened with beams quoted at 1.40c, Pittsburgh, and an official cut of $1 a ton became effective June 1. In September, the market dropped to 1.30c, Pittsburgh, and at the close of that month sales were reported at 1.25c, Pittsburgh. Further weakness developed in October, the market dropping to 1.20c, Pittsburgh. At the beginning of November, the market ruled at about 1.15c, and within three weeks dropped to 1.10c, Pittsburgh, the lowest level in several years. Early in December, there was a noticeable improvement and prices were advanced from $1 to $2 a ton.

Rails

As was the case in previous financial depressions when prices on all steel products were reduced, the steel rail market is the one branch of the trade which did not suffer a reduction in prices during 1911. When the year opened, rail makers did not expect a heavy demand for steel rails on account of the retrenchment policy railroads followed all through the year 1910, as the railroads had previously placed orders covering their requirements for extensions and renewals and it was evident that buying during the greater part of the year would be light. The steel rail production in the United States in 1910 was 3,634,029 tons, against 3,023,845 tons in 1909, and 3,633,654 tons in 1907, while production during the year just closed was far below that of any of the years referred to above. A number of the steel rail mills in certain sections of the the country where little new construction work was undertaken were closed for a large portion of the year, while others operated at from 30 to 40 per cent of capacity. The first inquiry for 1912 steel rails was put out late in October by the Norfolk & Western railroad and called for 25,000 tons. At the close of the year, the Pennsylvania, New York Central, Baltimore & Ohio and other larger lines were figuring on 1912 requirements and indications pointed to heavy buying during the initial month of the new year.

Sheets

During the year just closed, prices on sheets reached the lowest level in the history of the trade. Production, however, was about equal to that of 1910, which was a fairly satisfactory year from a tonnage standpoint. Late in December, 1910, sheet manufacturers met in Pittsburgh and decided to make a strong effort to maintain the market on a basis of 2.20c, Pittsburgh, for black sheets No. 28 gage, and 3.20c, Pittsburgh, for galvanized sheets No. 28 gage. On Jan. 7, another meeting was held and reports indicated a slight improvement in the volume of business. Manufacturers again met on April 5 and it developed that a large number of the mills were shading prices. During the latter part of April, there was a reduction of $1 a ton, and, while these prices were quoted all through the month of May, there was more or less shading. On June 1, a new card was issued showing a reduction on blue annealed sheets of $3 a ton, to 1.50c, Pittsburgh. Black sheets were cut $4 a ton to 2c, Pittsburgh, and a similar reduction was made on galvanized sheets, the price being cut to 3c, Pittsburgh. There was a cut of $3 a ton on painted roofing sheets to $2.40, Pittsburgh, and a cut on galvanized roofing sheets to $2.55, Pittsburgh. A few minor changes were also made in the arrangement of gages on black and galvanized sheets. The low prices brought out a larger volume of business and bookings in June were very heavy, some companies reporting a large increase in bookings over any previous month in a year. Early in August, a further concession of $1 a ton was offered and before the end of the month some mills were offering black sheets at 1.90c, Pittsburgh. A further concession of $1 a ton was also offered on galvanized sheets in September. In October, the market sagged further, sales of black sheets being made at 1.85c, Pittsburgh, and galvanized sheets at 2.90c, Pittsburgh. During this month, mills having favorable locations adopted the policy of quoting f. o. b. mill instead of Pittsburgh, with the result that sales were made at prices, which, if figured back to a Pittsburgh basis, were equivalent to 1.77½c to 1.80c, Pittsburgh, for black sheets and 2.77c to 2.80c, Pittsburgh, for galvanized. All through the month of November, the market was quiet and weak. During the second week in December, the American Sheet & Tin Plate Co. withdrew all low quotations and quoted 1.40c, on blue annealed No. 10 gage; 1.90c, on black sheets No. 28 gage, and 2.90c, Pittsburgh, on galvanized sheets No. 28 gage. A few days later, independent manufacturers took similar action and at the close of the year the market appeared to be firm at these figures. On Dec. 20, application was made in the Allegheny county courts, Pittsburgh, for a charter for the Association of Sheet and Tin Plate Manufacturers, with 15 charter members, the object of the association being the social enjoyment of its members; to stimulate and exploit the use of their product; to better the conditions of employes and to collect facts relating to the industry. The most important addition in the way of new mills was the completion of the Gary plant of the United States Steel Corporation, which was placed in service about June 11.

Tin Plate

Production of tin plate in 1911 established a new high record, the increase in output over the previous high mark being estimated at approximately 2,000 boxes. During the year 1910, this was the one branch of the finished steel trade in which prices were not reduced, the price being $3.60, Pittsburgh, for 14 x 20, 100-pound cokes throughout the year. The year 1911 opened with the outlook for this branch of the trade very bright. On Feb. 3, there was an advance of 10 cents per base box, or $2 a ton, prices on medium grades of terne and charcoal plate differentials being readjusted. On March 8, the Texas Co. placed an order with the American Sheet & Tin Plate Co. for 50,000 boxes of tin plate, this being the first large order placed with domestic mills by this company, which in previous years had obtained its supply from Welsh makers. On April 25, manufacturers held a meeting in Pittsburgh and at that time it was estimated that mills were operating at 90 per cent of capacity. The usual mid-summer shut-down of tin mills in July was of short duration on

account of the heavy demand. Late in August, the first evidence of shading of $3.60, Pittsburgh, appeared. On Oct. 16, the mills opened their books for 1912 business and announced a cut of $4 a ton, as compared with the market level for the previous 60 days, and a reduction of 30 cents per base box, or $6 a ton, as compared with the price established Feb. 3, 1911.

On Jan. 25, the McKeesport Tin Plate Co. completed two new tin mills at McKeesport, Pa., making a total of 22 tin mills. About Sept. 1, the Jones & Laughlin Steel Co. completed its second unit of 12 tin mills at Aliquippa, Pa., doubling the capacity of this company and giving it an annual output of 2,000 boxes. The second unit of 12 mills was placed in service late in December.

Merchant Pipe and Boiler Tubes

The year just closed was not a satisfactory one for the market on pipe. Production was not far below that of the preceding year, but prices sagged throughout the 12 months and at the close of the year were the lowest on record. Despite the fact that production during the second and third quarters was extremely low, with some mills operating about 40 per cent of their capacity, the total output for the year compared favorably with that of 1910. During the latter part of January, mills were operating at about 60 per cent of capacity and during the summer months dropped to from 40 to 45 per cent, increasing to about 70 per cent at the close of the year. On Oct. 2, a new card became effective, showing a reduction of $2 a ton on merchant black steel pipe, with the exception of ⅜ and ½-inch, on which the reduction was $4 a ton; a reduction of from $6 to $14 a ton on galvanized merchant steel pipe and a reduction of $2 a ton all through the list on extra strong and double extra strong pipe. The new card showed a re-arrangement of the smaller sizes of merchant pipe and on ⅛ and ¼-inch the price was advanced $2 a ton on black steel pipe, while on galvanized steel pipe the price on these sizes was advanced $10 a ton. Effective on the same date, manufacturers of iron pipe reduced prices $2 a ton on ⅜-inch and ½-inch black pipe and $4 to $12 a ton on lap weld and butt weld galvanized iron pipe. As a result, the new differential in prices of black and galvanized steel pipe and black and galvanized iron pipe was established at $10 a ton instead of $8 a ton, as was the case under the previous cards. With the issuing of this card, manufacturers of steel pipe advised the trade that they would guarantee prices against further decline up to Dec. 31, on all business placed within 60 days of the date of the new card. This was followed Dec. 1 with a further reduction of $2 a ton on butt weld merchant steel pipe and $4 a ton on all sizes of lap weld merchant steel pipe, except 13 to 15 inches, on which the reduction was $6 a ton. Manufacturers of iron pipe did not reduce prices at that time.

The largest contract placed during the year and probably the largest single contract ever awarded, was the 40,000 tons of 4½ to 16-inch steel line pipe, awarded to the National Tube Co. by the Canadian Western Gas, Light, Heat & Power Co. Other large awards included orders aggregating 300 miles of 6-inch steel pipe by the Texas Co.; 180 miles by the Gulf Refining Co.; 80 miles of 2 to 16-inch steel pipe for the Tri-County Natural Gas Co.; 52 miles of 2 to 12-inch steel pipe for the Oklahoma Natural Gas Co., and about 10,000 tons of various sizes of iron pipe for the Philadelphia Co., Pittsburgh.

The market on boiler tubes throughout the year was unsatisfactory. At no time during the 12 months was the demand up to the capacity of the mills, with the result that prices were not very firm except during the first quarter of the year. On Dec. 1, a new card was issued on iron and steel boiler tubes, showing reductions of from $4 to $5 a ton.

Wire Products

Due to increased capacity rather than a curtailment in consumption, conditions surrounding the wire market were unsatisfactory during the greater part of the year and extreme competition developed exceedingly low prices during the last half. The Jones & Laughlin Steel Co. doubled the capacity of its rod plant and wire mills at Aliquippa, Pa., and the company now has an annual capacity of 200,000 tons of rods, of which 150,000 tons are used in the company's wire mills and 50,000 tons disposed of in the open market. The Cambria Steel Co. during the year entered the field as a manufacturer of wire products, having completed a rod and wire mill on a site of 21 acres, about two miles from the Cambria works at Johnstown, Pa. The company now has a capacity of about 125,000 tons of wire rods a year. Despite the unsatisfactory price situation, the larger companies made a new high production record during the year. The estimated output of the American Steel & Wire Co. for the 12 months is 1,800,000 tons, compared with 1,624,000 tons in 1910 and 1,746,838 tons in 1909, which, up to that time, was the banner year in the history of the company.

The year opened with wire nails firm at $1.70, Pittsburgh, and plain wire at $1.50, Pittsburgh, to jobbers. On Jan. 20, there was an advance of $1 a ton and a second advance of $1 a ton was made with the close of business, March 4. Late in May, slight concessions were offered by some mills and on June 20 there was a general cut of $2 a ton. Late in August, another concession of $1 a ton was freely offered and in a week or so all mills began quoting on a new level, $1.65, Pittsburgh, for nails, and $1.45, Pittsburgh, for plain wire. Early in November, the market dropped another $1 a ton and during the latter part of that month a further cut of $1 a ton was made, making quotations $1.50, Pittsburgh, on wire nails, and $1.30, Pittsburgh, on plain wire, these being the lowest prices quoted in this market in 12 years. On Dec. 11, there was a general advance of $1 a ton, making nails $1.55, Pittsburgh, and wire $1.35, Pittsburgh. At the close of the year, there was talk of another advance of $1 a ton, to become effective about the first of the year.

Old Material

The year opened with heavy melting steel ruling at $13.50, valley, but at the close of the initial month prices dropped 25 cents a ton. Late in February, there was an advance to $14 and in March the market reached $14.75, delivered, which was the high point of the year. The market declined rapidly and in April dropped to $13, delivered, Pittsburgh. In May, there was a further reduction of 50 cents a ton, while in June demand for heavy melting steel increased and sales were made at $13, delivered, this price being held until the first of August, when it advanced to $13.25. Reductions of 25 cents a ton were made about every 10 days until the first week in October, when the market ruled at $12, delivered, this price being effective during the month of November, also. Demand increased during the closing month and heavy sales were made at $12.50 to $12.75, delivered. Price fluctuations on other grades of scrap were similar to those on heavy melting steel. On account of the increased capacity of open-hearth steel furnaces during the year,

demand for heavy melting steel was heavy during the last quarter.

Labor Conditions

It is noteworthy that the year just closed was free from any serious labor disturbances. The Republic Iron & Steel Co., on June 27, reaffirmed the 1910-11 wage scale at a conference with officers of the Amalgamated Association of Iron, Steel and Tin Workers, and this was followed within a week or so by similar action on the part of the Western Bar Iron Association, which previously announced that it would demand a reduction for the year beginning July 1. One June 23, the independent sheet and tin plate manufacturers dealing with union labor reafirmed the wage scale presented by the Amalgamated Association. Aside from a few minor changes in the foot-notes, the agreement was exactly the same as the one which became effective July 1, 1910. During the midsummer season, when prices of finished steel products reached the lowest level in years, there was talk of a general reduction of 10 per cent in wages, but, with the exception of a few of the smaller companies, which forced their men to accept a slight reduction, the wage scales throughout the year were the same as for the preceding year.

The following table shows the bi-monthly bar iron card settlements between representative makers of bar iron and the Amalgamated Association of Iron, Steel and Tin Workers with the changes in the wage scale for puddlers.

	Bar Iron Card.	Wage Rate for Puddlers.
January-February	1.35c	$5.87½
March-April	1.30c	5.75
May-June	1.25c	5.62½
July-August	1.25c	5.62½
September-October	1.20c	5.50
November-December	1.20c	5.50

Beginning with March 1, three western mills in the Chicago territory figured in the bi-monthly bar iron card settlement and this, to some extent, explained the low card, as bar iron was sold at lower prices by the Chicago mills than by those in the Pittsburgh territory.

New Construction

Blast Furnaces.

(Non-Merchant.)

Hazelton No. 4, Youngstown, O., Republic Iron & Steel Co., completed and lighted June 8.

Furnaces "J" and "C", Braddock, Pa., Carnegie Steel Co., rebuilt and enlarged.

No. 3 furnace of Eliza group, Jones & Laughlin Steel Co., rebuilt and enlarged.

Two furnaces to be built at Monessen, Pa., by the Pittsburgh Steel Co., for which contracts were awarded in December.

Blast Furnaces

(Merchant.)

No. 2, Josephine, Pa., Corrigan, McKinney & Co., completed.

Clinton furnace, Southside, Pittsburgh, Clinton Iron & Steel Co., rebuilt.

No. 1 stack, Sharpsville, Pa., Shenango Furnace Co., rebuilt and enlarged.

Steel Works

Republic Iron & Steel Co., eight 60-ton open-hearth steel furnaces, blooming mill, billet and sheet bar mill, Youngstown, completed.

Youngstown Sheet & Tube Co., contracts awarded for six open-hearth steel furnaces, blooming mill, billet and sheet bar mill, Youngstown.

Pittsburgh Steel Co., contracts awarded for four additional open-hearth steel furnaces at Monessen, Pa.

Jones & Laughlin Steel Co., four 250-ton open-hearth steel furnaces, blooming mill, billet and sheet bar mill completed at Aliquippa, Pa.

Pittsburgh Crucible Steel Co., contracts awarded for six open-hearth steel furnaces, blooming mill and billet mill, at Midland, Pa.

Whitaker-Glessner Co., Wheeling, W. Va., plans prepared in 1910 for open-hearth steel plant near Martins Ferry, O., but no authority to begin construction.

Sheet Mills

Follansbee Bros. Co., two mills completed at Follansbee, Pa.

American Rolling Mill Co., ten mills completed.

West Penn Steel Co., contracts prepared for three additional mills at Brackenridge, Pa.

American Sheet & Tin Plate Co., new plant at Gary, consisting of 16 sheet and four jobbing mills, completed.

Tin Plate

Jones & Laughlin Steel Co., second unit of 12 tin mills, Aliquippa, Pa., completed, giving 24-mill plant.

McKeesport Tin Plate Co., McKeesport, Pa., two tin mills completed, making total of 22 tin mills.

Washington Tin Plate Co., Washington, Pa., old plant containing five mills rebuilt, two new mills added, one old mill abandoned, making six-mill plant.

Rod and Wire Mills.

Jones & Laughlin Steel Co., new wire rod mill consisting of 16 trains of rolls, doubling capacity and giving the company an annual output of 2,000,000 tons.

Cambria Steel Co., Johnstown, Pa., rod and wire mill, described in THE IRON TRADE REVIEW, March 23, 1911.

Other Finishing Mills

Jones & Laughlin Steel Co., merchant bar mills.

Republic Iron & Steel Co., 90-inch plate mill and merchant bar mill, Youngstown, completed.

Sharon Steel Hoop Co., Sharon, Pa., merchant mill for rolling wide bands and strips, completed.

A. M. Byers & Co., new plate mill, Girard, O., completed; three welding furnaces and other improvements completed at Southside, Pittsburgh, Pa., plant.

Pittsburgh Steel Co., plans being prepared for merchant bar mill to be built at Monessen, Pa.

Will Double Dock Capacity

With work on recently-awarded contracts completed, the Soo Line's ore dock at Superior will be doubled in capacity. Now 600 feet long and with 100 pockets, the pier will be lengthened to 1,200 feet and given 100 additional pockets. Four million feet of timber will be used in construction work. The cost of the extension will approximate $225,000. The Soo Line is so far the only railroad handling ore from the new Cuyuna range, southwest of the Mesabi, and it is for the purpose of adequately caring for the increased outgo to come from that district the coming year that the Superior dock is to be enlarged. The Cuyuna entered the shipping list only this year. It sent out approximately 300,000 tons, all of which was from Rogers, Brown & Co.'s Kennedy mine. It is expected that during the coming year five or six properties will be shipping. The dock extension will be completed by the first of May.

The Trow & Holden Co., Barre, Vt., advises that it has been formed to take over the business of the old firm of Trow & Holden, also of Barre, which manufactures pneumatic and granite working tools, and that no new equipment will be required at present.

Eastern Market Review

(Continued from page 7.)

enly quoted in November, and there were substantial indications that some Lehigh valley metal of this grade had gone closely to $14, delivered, at certain points, or about $13, furnace. Several lots of Alabama basic sold in the east in the year around $14.25, delivered, at times when the local makers would not name such a price. The extreme position of the basic market in the east is reflected by the fact that one central Pennsylvania steel works blew out its two furnaces and bought its requirements in the open market, supporting the assumption that it could buy metal more cheaply than it could make it. Eastern steel works continue to work toward a position that will make them independent in their iron needs. Negotiations had been practically completed at the year's close for the leasing of the furnace plant of the Warwick Iron & Steel Co. by the Eastern Steel Co. which will take an important buyer out of the market. The Delaware river cast iron pipe workers, as usual, were heavy purchasers in the year, taking several hundred thousand tons of northern metal as well as a heavy tonnage from the south. Pipe iron ruled in the year between the figures of $13.50 to $14.50, delivered. Generally, northern furnaces would not go below $14, delivered, on such iron, though one or two furnaces with freight advantage dropped below $13.75, delivered, at times. The demand for standard forge iron in the year was light, owing to the inactivity of the rolling mills. Prices ranged between $14.25 and $14.75, delivered. Low phosphorus iron showed a decline over the year, opening around $21.50, Philadelphia, and closing at $19 to $19.25, Philadelphia. Sales were fair. Aside from November, the most active buying movement came in January.

The Virginia market showed only a fractional volume of selling and prices were low throughout the year. On Jan. 1, 1911, No. 2X iron was quoted about $12.75, Virginia furnace. It rose to $13, furnace, in March and April, but fell back to $12.25, furnace, during the last quarter. The most radical break in prices came in May, when the Virginia Coal, Iron & Coke Co. reduced its schedules 75 cents. Stocks in that territory at the beginning of 1912 were about 200,000 tons, of which approximately 180,000 tons was in the hands of the leading producer there and most of it had been carried for several years. Six furnaces were blowing and 15 were idle.

Stimulated by price concessions to $9.50 and $9.75, Birmingham, on No. 2 foundry and $9.60 on basic, an enormous movement of southern iron developed in November and about 300,000 tons were sold. Of this total, the bookings of the Tennessee Coal, Iron & Railroad Co. were about 200,000 tons, and the Republic Iron & Steel Co. was also a liberal seller. This drive for business was followed by the largest and most consistent buying movement of the year in practically all market centers.

Scrap prices in the east during 1911 were uniformly low and the demand, because of the moderate melt of the largest eastern consumers, was not large. The highest point in heavy steel, railroad wrought and other grades was reached in January and February with steel at $14.25, delivered, and wrought at $17, delivered. From then until December, when the market again started to rise, there was a steady decline.

Banner Year in Exports

Several notable features of the year of a favorable character stand out prominently in the after-look and both of these have related to the re-establishment to the nation's maritime commerce and to its more active representation in the markets of the world. The year has been a remarkable one in the great increase of the exports of iron and steel products, which will be about 2,300,000 tons, as compared with 1,500,000 tons in 1910, the previous largest year. The valuation of the exported products will be about $250,000,000, an increase of approximately $100,000,000 over last year. A notable feature of the export movement of the year has been the capture by American tin plate manufacturers, through the operation of the drawback clause in the tariff, of the re-export tonnage of this product, which had previously gone to Welsh makers. Among the principal contracts of this class booked in this country have been the heavy requirements of the Standard Oil Co. for the containers in which it ships its products abroad. These contracts alone have called for about 1,000,000 or more boxes of tin plate annually, which has gone solidly for the first time to the American Sheet & Tin Plate Co., through the export subsidiary of the United States Steel Corporation. The Texas Co., also for the first time, placed large orders with domestic manufacturers for its re-export tin plate requirements. The total exports of American tin plate in 1911 will be about 55,000 tons, compared with about 10,000 tons in 1910. The imports of tin plate dropped from about 57,000 to 14,000 tons. Low domestic prices and an advanced foreign market are the causes for this reversal of precedent. Other large export contracts taken in the year were about 80,000 tons to the Carnegie Steel Co. for the Quebec bridge; 40,000 tons of line pipe to the National Tube Co. for shipment to the province of Alberta, Can., and other important contracts. Some heavy rail sales have been made, principally for shipment to Canada, Mexico and South American countries. The United States Steel Products Co., the export subsidiary of the United States Steel Corporation, has been by far the largest export shipper, gaining probably 90 per cent of the trade, or about 2,000,000 tons. Its export orders for the first half of the year were about 1,000,000 tons. This interest has pushed its activities on an unprecedented scale into the various markets of the world. Its great expansion of export tonnage is clearly the result of a greater latitude given to its foreign policies through the presence as its selling head of Mr. Farrell, an acknowledged pastmaster in the export trade. In the heavy export tonnage lies the chief explanation of the fact frequently alluded to that the Steel Corporation has been persistently able to maintain its operations on a higher scale than its competitors. Its export trade in the year has reached about 20 per cent of its total output. The active movement of the American steel products into the markets of the world has undoubtedly exercised a very salutary effect upon the domestic industry in which handling an apparent over-capacity, especially in times of restricted home buying, has presented a serious question as to keeping capacity employed

Ship Building Industry Revives

One of the striking developments of the year has been the rehabilitation of active ship building along the eastern coast, an industry which, in some respects, has seemed to be in a decadent state. The Atlantic ship yards have had an extraordinarily large amount of work presented before them for estimate and bids during the year and these undertakings in their aggregate at times presented the heaviest tonnage that has ever been before the yards on one occasion in all their history, according to the statement of some of the veteran ship builders. The direct stimulus for this rejuvenation of ship building interest is generally attrib-

uted to the approaching completion of the Panama canal and its promised opening to the commerce of the world in 1913. The most important vessel contract placed in the year was given by the American-Hawaiian Steamship Co. to the Maryland Steel Co., Sparrows Point, Md., and calls for the construction of five large freight steamers, each of 9,000 tons burden. The government placed one collier with the Maryland Steel Co. and one with the Newport News Ship Building & Dry Dock Co; the Standard Oil Co. awarded two tank boats to the New York Ship Building Co.; the Clyde Steamship Co., one boat with the Newport News Ship Building & Dry Dock Co.; and there were numerous other contracts placed of miscellaneous nature. A large volume of business is now pending. The building of the American-Hawaiian boats, with other work on hand, will practically fill the ways of the Maryland Steel Co. for two years. Other eastern plants were well filled with work at the year's close and some of them were obliged to decline invitations to bid upon additional tonnage. The interesting outcome of this condition of well filled order books toward the end of the year was the entrance of lake ship yards into competition for the building of several coastwise vessels.

Fabricated Steel

It is estimated on good authority that the fabricated steel tonnage placed in 1911 will exceed by 10 per cent the highest total of any other year in history and will be about 1,800,000 tons, with a possibility of reaching 2,000,000 tons, if the great mass of smaller work, not usually reported, is included. The largest previous year in reported work was in 1906, with about 1,600,000 tons placed. The bookings of the American Bridge Co. will be about 700,000 tons, or approximately its full rated capacity of 720,000 tons, annually. In November it booked over 100,000 tons and this was the largest month of the year. For work to be done in the immediate metropolitan district, about 300,000 tons or fully a normal year, was placed under contract, while the total lettings made in the New York market, but for manufacture and delivery in outside districts, will add about 300,000 tons more. The New York territory put out some unusually large work this year, an important part of which came from the inauguration of construction of the new tri-borough subway system. The American Bridge Co. booked about 40,000 tons of this work. The ultimate requirements of the proposed extensions will be about 300,000 tons. Other large lettings were 36,000 tons for the Hell Gate bridge connecting Long Island and the mainland, with 40,000 tons still pending; 12,000 tons for the McAlpine hotel, 22,000 tons for the Woolworth skyscraper and 8,000 tons for the Insurance Exchange, all of this city, and 12,000 tons for a bridge at Kenova, W. Va., for the Norfolk & Western railway. All these awards went to the American Bridge Co. The Metropolitan Street Railways Co. offered 80,000 tons for elevated extensions, but did not close. The 22,000 tons for a loft building to replace Madison Square Garden is still pending.

Fabricated prices suffered severely, especially after the open market in finished products, and in some cases bids for commercial buildings went below $35.00 a ton, delivered. Much work was taken at $35 to $40, delivered in the eastern market. Plain material prices went to 1.10c, Pittsburgh, in numerous cases and in some instances of inside business, 1.05c, Pittsburgh basis, was reported. At the close of the year, the plants of the American Bridge Co. were running full and they had a heavy unfilled tonnage upon their books. Some independent shops, especially in the east, were in a much less fortunate position.

Railroad Buying Slow

Railroad buying in the year past has shown no large measure of increase from the disappointing volume of the several previous years. Reliable analyses made by leading steel makers during the most active buying periods of the year, in finished lines showed that not more than 10 to 15 per cent of the tonnage entered could be traced to railroad sources. Early in the year, it was thought that the uncertainties surrounding freight rate decisions pending before the interstate commerce commission were exercising a retarding influence. Obviously the railroads let this view of the case be assumed. When the interstate commerce commission rendered its decision, Feb. 23, denying the petition for increased rates, the buying temper of leading systems naturally was not improved. Not until the appearance of such alluring prices as were offered by the car builders in October, made possible by the remarkably low steel protections, did the railroads actively take hold of the equipment market. In that month, about 18,000 cars were purchased and this paved the way for a vigorous period of purchasing in November, when 40,000 additional cars went under contract. Car prices, which had dropped as low as $700 for first class freight cars, then reacted and the buying relapsed somewhat. In October and November, as many cars were bought as during the remaining ten months of the year. The largest order placed was by the New York Central system for 22,000 cars. The Baltimore & Ohio bought 8,500 cars, while the Pennsylvania railroad at the year's close had inquiries out for 17,000 cars and was considering a much larger number. The total number of freight cars placed by the railroads of the United States in 1911 is estimated around 125,000, compared with about 80,000 in 1910. Motive power buying was poor. Among the largest locomotive orders placed were 120 by the New York Central, divided for the first time between the Baldwin and the American companies, 75 for the Chicago & Northwestern, 70 for the Illinois Central and some others.

Rail bookings in the year were about 2,700,000 tons, a considerable part of which was for export. The Pennsylvania railroad order for delivery in 1911 was placed in December, 1910, but did not reach the mills until in January because of negotiations over specifications. The New York Central followed immediately thereafter with the distribution of 176,750 tons, the largest order of the year. The Harriman lines did not close until April, when 72,000 tons was placed. Buying for 1912 delivery began with the bookings of the Norfolk & Western for 25,000 tons and of the Louisville & Nashville for 50,000 tons in November. By Jan. 1, 1912, about 400,000 tons had been put on the books for that year's rolling. This did not include the New York Central and Pennsylvania tonnages, which were still under negotiation.

Steel Corporation's Tonnage

The total ingot production of the United States Steel Corporation in 1911 will be between 12,500,000 tons and 13,000,000 gross tons, compared with 14,179,369 gross tons in 1910, and its finished output from 9,500,000 tons to 10,000,000 tons. The total ingot output of the country, it is estimated, will be about 23,000,000 tons.

Ingot production of the Corporation was heavier in the second half than in the first. At the end of 1911, the United States Steel Corporation had the heaviest order tonnage upon its books in more than a year and a half, or since the quarter ended March 31, 1910. Its plants prior to the usual holiday shut-down, were operating at

70 to 75 per cent of capacity, but it was announced that with the resumption of the Columbus works, production would probably reach 85 and possibly 90 per cent early in the year. In November, the bookings exceeded 45,000 tons daily. During the first part of December, daily bookings exceeded 50,000 tons.

The official monthly record of the unfilled tonnage of the Steel Corporation in 1911 has been as follows:

Date.	Total.	Change. Tonnage.
Dec. 31, 1911 (estimated)	4,500,000	360,000+
Nov. 30, 1911	4,141,955	447,627+
Oct. 31, 1911	3,694,328	83,011+
Sept. 30, 1911	3,611,317	84,668—
Aug. 31, 1911	3,695,985	111,900+
July 31, 1911	3,584,085	223,027+
June 30, 1911	3,361,058	247,871+
May 31, 1911	3,113,187	105,617—
Apr. 30, 1911	3,218,704	228,597—
Mar. 31, 1911	3,447,301	46,758+
Feb. 28, 1911	3,400,543	289,624+
Jan. 31, 1911	3,110,919	436,162+
Dec. 31, 1910	2,674,757	85,656—

Machine Tool Trade Unsatisfactory.

The year of 1911 in machine tool trade and in most branches of the machinery industry will pass into history as being an unsatisfactory period, as business was much below normal. Orders of the railroad companies were disappointingly light, in view of the fact that a large total of requirements had been carried forward from 1910 and was expected to be provided for during 1911. The manufacturing trade, of which the automobile industry furnished a large part, supplied most of the year's buying of this order, but the same policies of restricting installations to replacements was also reflected among these interests. Exports of machine tools and machinery in the year were of good volume. Among the principal machine tool lists closed in the New York market in the year were those of the New York, Ontario & Western railroad for its new shops at Dunkirk, N. Y., aggregating $60,000, of the Delaware, Lackawanna & Western for about $50,000, and of the Pennsylvania General Electric Co. for about $75,000 for tools for its new Erie, Pa., plant.

The American Steel & Wire Co. also placed in the year machine tool requirements aggregating about $2,000,000. This business went to those sellers and builders whose plants were located nearest the works to which the tools were distributed.

Important Business Events

Some important business changes in the iron and steel industry fell within the year, most of them of a local eastern significance. On Jan. 31, James A. Farrell, president of the United States Steel Products Co., became president of the United States Steel Corporation, succeeding William E. Corey, resigned. Eugene P. Thomas was made president of the United States Steel Products Co. The Alan Wood Iron & Steel Co. carried out the final details of absorbing the Richard Heckscher & Sons Co., and increased its capital to $9,000,000. The Lebanon Valley Iron & Steel Co., Lebanon, Pa., absorbed the Duncannon Iron & Steel Co., and increased its capital from $1,000,000 to $2,000,000. In the south, a plan was evolved for the consolidation of the Alabama Consolidated Coal & Iron Co. and the Southern Iron & Steel Co., and the re-organization is now in the process of consummation.

Of international significance was the conference of iron and steel makers of the world at Brussels, Belgium, in July, which was attended by a score of leading iron and steel masters of the United States. The advisability of forming an international organization was left to the determination of a special committee for later report. No final action upon this matter has yet been forthcoming.

NEW CONSTRUCTION.

Blast Furnaces.

(Non-Merchant.)

Bethlehem Steel Co., South Bethlehem, Pa.: New furnace G, 22 x 90 feet, completed and blown in July 29; daily capacity present ores, 425 to 450 tons. New furnace F, 22 x 90 feet, completed and blown in March 15; daily capacity present ores, 425 to 450 tons. Furnace A, torn down and will be replaced with modern furnace. Present Bethlehem blast furnace plant consists of six furnaces, and one more is projected.

Maryland Steel Co., Sparrows Point, Md.: Furnace A, 20 x 85 feet, rebuilt and equipped with mechanical top, skip-hoist, etc.; capacity increased from 400 to 500 tons daily.

Worth Bros. Co., Coatesville, Pa.: Second furnace under construction. Daily capacity about 500 tons; will be completed about Feb. 1, 1912.

Alan Wood Iron & Steel Co.: Alternate stack, under construction at Swedeland, Pa.; daily capacity about 400 tons.

Blast Furnaces.

(Merchant.)

Colonial Iron Co., Riddlesburgh, Pa.: New furnace, 23 x 75 feet, completed and blown in in December; daily capacity 200 tons; replaces two small stacks which have been torn down.

Warwick Iron & Steel Co., Pottstown, Pa.: Alternate stack, 20 x 80 feet, practically completed; daily capacity, 350 to 400 tons.

Low Moor Iron Co., Low Moor, Va.: Furnace A, rebuilt and enlarged; daily capacity, 175 tons; never blown in.

Oriskany Ore & Iron Co.: Planning construction modern furnace plant at Lynchburg, Va.; estimated daily capacity, about 200 tons.

Steel Works and Finishing Mills

Bethlehem Steel Co., South Bethlehem, Pa.: New Bessemer plant equipped with two 20-ton converters, new 400-ton metal mixer and 250-ton metal mixer, formerly in open-hearth department, completed and placed in operation in March, using duplex method of steel making in conjunction with former open-hearth plant; machine shops, forge shops, projectile and armor plate departments, etc., enlarged and re-equipped with tools and other machinery; new power plants installed. Total cost of improvements, with four blast furnaces, $7,500,000. First unit of 300 by-product coke ovens under construction at South Bethlehem by Didier-March Co. to furnish Bethlehem works with coke fuel and gas; daily capacity about 3,500 tons coke. Will be completed about Sept. 1.

Alan Wood Iron & Steel Co.: Hot metal bridge across the Schuylkill river connecting steel works at Ivy Rock, Pa., with blast furnaces at Swedeland, Pa., completed and placed in operation; estimated will increase steel output of works by one-third.

Phoenix Iron Works, Phoenixville, Pa.: Additional open-hearth furnace completed and put in operation; capacity about 175 tons per heat.

Lackawanna Steel Co., Buffalo: New merchant mill completed and placed in operation in September; annual capacity about 130,000 tons of bar products; two additional 50-ton open-hearth furnaces under construction.

Lebanon Valley Iron & Steel Co.: Eight-inch finishing mill at Lebanon, Pa., plant, and two additional finishing mills at Duncannon, Pa., plant, increasing output to 350 tons daily, and other improvements projected.

Robert Porter, who has been connected with the mechanical engineering department of the Republic Iron & Steel Co., at Youngstown, has been appointed superintendent of the new plate and combination bar mills, at Lansingville, succeeding Frank Cunningham, who has been promoted to assistant general superintendent, to succeed Harry Parrock, resigned.

Low Prices and Decreased Production of Coke

Decline of Three Million Tons in Output Compared With 1910
—No General Buying Movement Until Later in November

Statistics showing production and prices of coke produced in the Connellsville region during the year 1911 do not make a very satisfactory showing when compared with reports of preceding years. The total production of the Connellsville region during the year 1911, compiled from the weekly reports of the *Connellsville Courier*, the production for the last half of December being estimated, is given as nearly 16,000,000 tons, as compared with approximately 19,000,000 tons in 1910; 17,785,832 tons in 1909 and 10,700,022 tons in 1908. Production in 1905, 1906 and 1907 exceeded that of 1911 by from 2,000,000 to 4,000,000 tons. Prices during the 12 months just closed were the lowest in many years, the high mark for prompt furnace coke during the year being $1.75, ovens, and the low mark $1.35, ovens, showing an average for the year of about $1.59, ovens, the lowest since 1898, when the average price for the year was $1.55, ovens. The average price for 1910 was $2.10, ovens.

AVERAGE QUOTATIONS ON COKE FOR PROMPT SHIPMENT AT THE OVENS.

	Furnace.		Foundry.	
	1911.	1910.	1911.	1910.
January	$1.41	$2.57	$1.97	$3.02
February	1.44	2.31	1.95	2.92
March	1.58	2.03	2.00	2.78
April	1.55	1.61	1.99	2.53
May	1.44	1.61	1.90	2.29
June	1.40	1.63	1.77	2.15
July	1.42	1.60	1.80	2.10
August	1.51	1.61	1.85	2.17
September	1.50	1.60	1.85	2.12
October	1.50	1.59	1.86	2.07
November	1.50	1.49	1.89	2.01
December	1.64	1.45	1.90	2.00

The highest production record during the year was for the week ending March 25, when the upper and lower regions produced 371,255 tons, which was at the rate of 19,303,700 tons per year, while the lowest weekly production was for the week ended June 10, when both regions produced 266,646 tons, which was at the rate of 13,865,592 tons a year. The year opened with a weekly production of 281,885 tons and with prospects of a fairly satisfactory production record throughout the year. From the opening of the year production gradually increased until the week ending March 25, the high point of the year. The following week showed a curtailment in production of about 3,000 tons and the output fell off gradually until the middle of June, which was the low point during the year. During the next two months, production ranged from 270,000 tons to 290,000 tons a week, and from that time on exceeded the 300,000-ton mark each week during the remainder of the year.

Price fluctuations during the year just closed were not as great as during the preceding year. In 1910, the average price of prompt furnace coke for January was $2.57, ovens, and each succeeding month showed a further decline, the average for the closing month of that year being $1.45, ovens. The year 1911 opened with prices weak, the average for January being $1.41, ovens. Prices were advanced slightly during February and March and during the last three weeks of March sales were made at $1.60, ovens. In December, there was a sharp advance in prices and on Dec. 21 a sale was made at $1.75, ovens, for prompt shipment. At no time during 11 months of the year did the monthly average exceed $1.58, ovens, which was only 13 cents above the lowest average in 1910 and 99 cents under the highest average of that year. The average monthly price of foundry coke in January, 1910, was $3.02, ovens, the high point of that year, as compared with $2, ovens, in March, the high point in 1911. The lowest average in 1910 was $2, ovens, while the lowest monthly average for 1911 was $1.80, ovens, which was for the month of July.

CONNELLSVILLE COKE PRODUCTION, 1911.

(Compiled from the weekly reports of the Connellsville *Courier*.)

Week, 1911.	Ovens.	In blast.	Out blast.	Tons.
Jan. 7	39,336	22,540	16,796	281,885
Jan. 14	39,474	22,632	16,842	280,320
Jan. 21	39,432	22,663	16,760	287,475
Jan. 28	39,431	23,832	15,599	291,705
Feb. 4	39,605	24,741	14,864	302,275
Feb. 11	39,617	25,873	13,744	323,333
Feb. 18	39,617	26,231	13,386	322,765
Feb. 25	39,617	26,160	13,457	339,388
Mar. 4	39,617	26,541	13,076	352,077
Mar. 11	39,617	27,148	12,469	357,471
Mar. 18	39,617	28,115	11,802	364,596
Mar. 25	39,617	28,377	11,280	371,255
Apr. 1	39,617	28,385	11,232	368,029
Apr. 8	39,399	28,514	10,885	362,769
Apr. 15	39,399	28,427	10,972	349,475
Apr. 22	39,399	26,297	13,102	312,942
Apr. 29	39,399	26,130	13,269	300,540
May 6	39,399	25,180	14,219	280,367
May 13	39,399	24,612	14,787	278,037
May 20	39,399	24,332	15,067	273,108
May 27	39,399	24,214	15,185	270,749
June 3	39,399	24,080	15,319	269,256
June 10	39,399	23,754	15,645	266,646
June 17	39,399	23,604	15,705	271,088
June 24	39,399	23,616	15,783	273,422
July 1	39,399	23,876	15,523	275,950
July 8	39,399	23,933	15,466	267,122
July 15	39,399	23,714	15,685	270,700
July 22	39,399	23,757	15,642	282,633
Aug. 5	39,165	24,377	14,788	290,767
Aug. 12	39,165	25,823	13,342	304,044
Aug. 19	39,165	25,887	13,278	313,722
Aug. 26	39,165	26,143	13,022	332,157
Sep. 2	39,165	25,992	13,173	347,284
Sep. 9	38,872	25,969	12,903	329,759
Sep. 16	38,872	25,999	12,875	310,743
Sep. 23	38,872	26,017	12,855	317,035
Sep. 30	38,902	26,034	12,868	313,652
Oct. 7	38,902	26,059	12,843	314,343
Oct. 14	38,902	26,166	12,736	310,205
Oct. 21	38,902	26,261	12,641	310,766
Oct. 28	38,902	26,273	12,629	320,300
Nov. 4	38,902	26,923	11,979	322,745
Nov. 11	38,902	27,005	11,897	323,363
Nov. 18	38,902	27,155	11,747	316,379
Nov. 25	38,904	27,255	11,679	330,793
Dec. 2	38,904	26,172	12,732	315,931
Dec. 9	38,904	26,014	12,890	319,130
Dec. 16	38,904	26,079	12,825	318,234
Dec. 23				*275,000
Dec. 30				*270,000
Total				15,944,630

*Estimated.

At no time during the first 11 months of the year was there a buying movement of any proportion until late in November, when contracts involving approximately 1,400,000 tons were announced for delivery over the year 1912 at $1.60 to $1.65, ovens, for first half delivery and $1.65 to $1.75, ovens, for delivery over the 12 months. The largest transactions involved in these contracts included 35,000 tons a month, or a total of 420,000 tons for shipment during 1912 to the Youngstown Sheet & Tube Co., and 25,000 tons a month during the year for the Republic Iron & Steel Co.

One of the interesting events during the year was the purchase of the coking coal lands of the Pittsburgh Coal Co. and the Monongahela River Consolidated Coal & Coke Co. by the United States Steel Corporation for approximately $18,000,000. The purchase included the coking coal, about 7,000 acres, and 955 ovens of the Colonial Coke Co.

During the year the railroads abolished the old differential freight rates on foundry coke from the Connellsville region to Chicago, Detroit and other western points and substituted a flat rate, the freight rates on foundry coke being reduced and the freight rates on furnace coke being advanced. During the third quarter, several producers and consumers of furnace coke filed a complaint with the interstate commerce commission against the advance in furnace coke freight rates.

Average Monthly Prices of Iron and Steel Products, 1900-1911

Finished Products in Net Tons. Pig Iron and Billets in Gross Tons

	1900											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$24.50	24.25	23.75	23.25	22.00	20.25	17.75	15.50	14.50	14.00	14.25	14.60
Gray Forge Cincinnati	$19.25	19.25	18.75	18.40	17.75	16.25	15.25	12.90	12.00	11.75	11.75	12.75
Plates Chicago	$52.50	50.00	45.25	42.00	38.75	32.75	28.00	25.00	26.00	25.00	29.25	30.75
Billets (Bess.) Pittsburgh	$35.00	35.00	35.00	34.50	29.00	27.25	22.50	18.00	17.50	17.50	19.30	19.75
Bessemer Pig Pittsburgh	$24.90	24.90	24.90	24.90	24.90	19.75	18.00	16.05	14.00	13.25	13.65	13.55
Beams Pittsburgh	$45.00	45.00	45.00	45.00	45.00	41.50	38.00	34.80	30.00	30.00	30.00	30.00
Bar Iron Cleveland	$43.00	43.00	43.00	40.50	37.25	33.00	26.00	24.00	25.00	26.00	26.75	26.75
No. 2 Foundry Birmingham												

	1906											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$19.25	19.25	19.00	18.75	18.50	18.10	18.30	18.90	19.75	21.50	26.50	27.00
Gray Forge Cincinnati	$15.75	15.05	14.85	14.75	14.75	14.65	14.55	15.40	16.50	17.50	21.70	22.00
Plates Chicago	$35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	37.30
Billets (Bess.) Pittsburgh	$27.00	27.50	27.65	27.75	27.00	26.25	27.00	28.00	28.50	28.50	29.00	29.75
Bessemer Pig Pittsburgh	$17.32	17.29	17.26	17.25	17.24	17.38	17.57	17.96	18.44	20.06	21.96	22.75
Beams Pittsburgh	$34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
Bar Iron Cleveland	$38.00	35.50	34.00	33.00	32.00	32.00	32.00	33.50	34.00	36.00	39.00	39.00
No. 2 Foundry Birmingham	$14.00	14.00	13.70	13.65	13.75	13.50	13.00	14.15	16.00	17.15	21.25	22.00

	1901											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$14.60	14.12	15.19	15.50	15.50	15.50	15.50	15.20	15.00	15.00	15.00	15.50
Gray Forge Cincinnati	$12.25	11.87	12.56	13.12	12.60	12.25	12.00	12.00	12.25	12.69	13.00	
Plates Chicago	$31.00	30.00	32.40	34.40	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.00
Billets (Bess.) Pittsburgh	$19.75	19.75	20.81	24.12	24.20	24.44	24.25	24.40	24.12	26.80	28.25	27.62
Bessemer Pig Pittsburgh	$13.25	13.60	16.56	16.69	16.65	15.94	16.00	15.90	15.71	15.90	16.10	16.35
Beams Pittsburgh	$30.00	30.00	30.40	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00
Bar Iron Cleveland	$25.80	27.80	29.30	30.80	29.80	29.80	29.40	30.80	30.60	32.80	32.00	31.70
No. 2 Foundry Birmingham												

	1907											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$26.00	26.50	26.75	27.50	27.40	26.50	25.40	24.50	23.60	22.60	20.60	19.00
Gray Forge Cincinnati	$22.60	22.50	22.70	21.50	21.90	21.35	20.55	19.95	18.85	18.45	17.35	15.50
Plates Chicago	$35.30	37.30	37.30	37.30	39.40	39.60	39.60	39.60	36.60	37.60	37.60	37.60
Billets (Bess.) Pittsburgh	$29.75	29.50	29.25	29.75	30.25	31.00	30.00	30.00	29.50	28.50	28.00	28.00
Bessemer Pig Pittsburgh	$22.92	22.78	22.85	22.16	24.10	24.10	23.30	22.90	22.90	22.80	20.60	19.90
Beams Pittsburgh	$34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.05	34.00
Bar Iron Cleveland	$39.00	36.50	36.00	36.00	35.00	34.00	34.00	33.00	33.00	32.50	31.00	31.00
No. 2 Foundry Birmingham	$23.00	23.00	22.75	22.00	21.40	21.25	20.50	19.80	18.12	17.65	16.00	14.91

	1902											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$15.80	16.75	18.62	19.75	21.75	22.50	23.40	24.66	27.15	27.15	26.90	25.40
Gray Forge Cincinnati	$13.75	13.75	15.25	16.00	17.05	18.93	20.00	21.50	21.50	20.60	18.87	18.00
Plates Chicago	$35.00	35.00	35.25	36.25	38.60	43.00	43.00	43.00	43.00	40.60	40.50	41.00
Billets (Bess.) Pittsburgh	$28.06	29.81	31.37	32.25	33.90	35.18	33.50	32.12	31.50	29.80	29.00	29.25
Bessemer Pig Pittsburgh	$16.70	16.93	17.56	18.37	20.95	21.25	22.00	21.75	21.75	21.95	22.25	22.12
Beams Pittsburgh	$32.00	32.00	34.00	37.00	40.00	45.00	45.00	47.00	45.00	43.00	42.00	40.00
Bar Iron Cleveland	$32.10	33.70	35.70	35.77	37.70	37.70	37.70	37.70	37.70	37.50	36.20	35.70
No. 2 Foundry Birmingham												

	1908											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$18.24	17.87	17.42	17.21	17.00	17.31	17.00	17.00	16.75	16.50	16.75	17.35
Gray Forge Cincinnati	$14.45	14.06	13.63	13.60	13.50	13.75	13.70	14.00	14.25	14.25	14.25	14.75
Plates Chicago	$37.60	37.60	37.60	37.60	37.60	36.60	35.60	35.60	35.60	35.60	35.60	35.60
Billets (Bess.) Pittsburgh	$28.00	28.00	28.00	28.00	28.00	26.50	25.00	25.00	25.00	25.00	25.00	25.00
Bessemer Pig Pittsburgh	$19.00	17.90	17.86	17.49	16.92	16.90	16.73	16.11	15.90	15.48	16.74	17.40
Beams Pittsburgh	$34.00	34.00	34.00	34.00	34.00	33.00	32.00	32.00	32.00	32.00	32.00	32.00
Bar Iron Cleveland	$28.80	27.00	28.00	28.40	30.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00
No. 2 Foundry Birmingham	$12.80	12.50	12.12	11.90	11.50	12.00	11.60	12.06	12.50	12.50	12.50	13.00

	1903											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$25.00	24.00	24.00	23.00	21.70	20.50	18.50	17.50	16.85	15.90	14.50	14.30
Gray Forge Cincinnati	$20.50	20.75	19.35	19.20	17.70	16.50	14.60	13.50	13.25	12.30	10.95	10.75
Plates Chicago	$35.00	37.00	38.00	40.00	37.75	35.00	35.00	35.00	35.00	35.00	35.00	35.00
Billets (Bess.) Pittsburgh	$29.75	30.00	30.25	31.00	30.50	29.50	27.50	27.00	27.00	26.50	23.50	23.00
Bessemer Pig Pittsburgh	$22.35	22.35	22.00	21.60	20.00	19.85	19.00	17.85	16.35	15.85	15.25	14.35
Beams Pittsburgh	$35.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00
Bar Iron Cleveland	$32.00	37.00	37.00	36.00	35.00	33.75	22.00	30.00	29.00	28.00	26.00	25.50
No. 2 Foundry Birmingham												

	1909											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$17.44	16.75	16.50	16.46	16.21	16.41	16.90	17.37	18.20	18.87	19.00	19.00
Gray Forge Cincinnati	$14.75	14.62	13.50	13.25	13.31	13.50	13.95	14.62	15.25	16.62	16.75	16.75
Plates Chicago	$35.60	34.10	29.60	28.60	28.95	28.60	30.60	31.60	32.80	33.60	35.60	35.60
Billets (Bess.) Pittsburgh	$25.00	23.50	23.00	22.00	22.50	23.00	24.00	25.00	26.00	26.50	27.50	27.50
Bessemer Pig Pittsburgh	$17.34	16.78	16.34	15.80	15.48	16.13	16.37	17.13	18.33	19.68	19.90	19.90
Beams Pittsburgh	$32.00	29.00	26.00	24.00	25.00	26.00	27.00	28.00	30.00	30.00	31.00	32.00
Bar Iron Cleveland	$29.00	28.75	26.20	25.25	25.00	26.20	29.25	30.00	30.00	30.00	32.00	32.00
No. 2 Foundry Birmingham	$13.00	12.70	11.75	11.00	11.00	11.31	12.30	13.00	14.00	14.50	14.50	14.00

	1904											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$14.10	13.75	13.55	14.00	13.80	13.40	13.30	13.35	13.40	13.70	15.60	16.60
Gray Forge Cincinnati	$11.00	11.00	11.25	11.75	11.25	10.75	10.75	11.00	11.00	11.75	14.25	15.00
Plates Chicago	$35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30	29.30	29.30	29.30
Billets (Bess.) Pittsburgh	$23.00	23.00	23.00	23.00	22.00	21.50	21.00	20.00	19.50	19.50	21.00	21.00
Bessemer Pig Pittsburgh	$13.60	13.35	13.85	14.10	13.60	12.60	12.50	12.65	12.75	13.35	15.25	16.60
Beams Pittsburgh	$32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	28.00	28.00	28.00	30.00
Bar Iron Cleveland	$25.00	26.00	27.00	29.00	29.00	28.00	28.00	25.00	25.00	27.00	28.00	32.00
No. 2 Foundry Birmingham	$ 9.75	9.50	9.70	10.00	9.65	9.15	9.15	9.50	9.50	10.65	12.75	13.05

	1910											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov	Dec.
No. 2 Foundry Chicago	$19.00	18.75	18.25	17.00	16.75	16.50	16.50	16.50	16.50	16.00	16.00	16.00
Gray Forge Cincinnati	$16.50	16.38	15.75	14.88	14.56	14.35	14.12	13.75	13.75	13.75	13.75	13.75
Plates Chicago	$35.60	35.60	34.60	33.60	33.60	32.60	31.60	31.60	31.60	31.60	30.60	30.60
Billets (Bess.) Pittsburgh	$27.87	27.50	27.50	27.00	26.12	25.50	25.00	25.00	24.50	23.38	23.00	23.00
Bessemer Pig Pittsburgh	$19.90	19.42	18.90	18.15	17.09	16.73	16.40	16.21	15.90	15.90	15.90	15.90
Beams Pittsburgh	$31.00	31.00	30.40	30.00	30.00	29.20	28.20	28.00	28.00	28.00	28.00	28.00
Bar Iron Cleveland	$33.00	33.00	33.00	32.50	31.00	30.10	28.00	28.00	28.00	28.00	27.80	27.00
No. 2 Foundry Birmingham	$14.00	13.88	13.00	12.12	11.81	11.60	11.38	11.00	11.00	11.00	11.00	11.00

	1905											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$17.50	17.50	17.50	17.50	17.25	16.60	16.15	16.35	16.50	17.55	18.90	19.50
Gray Forge Cincinnati	$15.25	15.20	15.00	15.20	14.81	13.35	12.28	13.00	13.00	13.88	15.35	15.75
Plates Chicago	$31.30	32.30	32.30	34.80	35.30	35.30	35.30	35.30	35.30	35.30	35.30	35.30
Billets (Bess.) Pittsburgh	$21.00	24.90	24.60	25.50	23.50	22.00	22.00	23.50	25.75	25.95	26.30	26.50
Bessemer Pig Pittsburgh	$16.85	16.45	16.35	16.30	16.20	15.65	15.00	15.40	15.90	16.50	17.70	18.10
Beams Pittsburgh	$30.00	31.00	32.00	32.00	32.00	32.00	32.00	32.00	34.00	34.00	34.00	34.00
Bar Iron Cleveland	$33.25	33.00	32.00	32.00	31.50	30.00	29.75	32.00	34.00	34.25	37.20	40.00
No. 2 Foundry Birmingham	$13.50	13.50	13.50	13.25	12.75	11.85	11.00	11.65	11.75	12.50	14.00	41.00

	1911											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
No. 2 Foundry Chicago	$15.00	15.00	15.00	15.00	15.00	15.00	15.00	14.50	14.50	14.50	14.00	14.00
Gray Forge Cincinnati	$13.35	13.25	13.15	13.05	12.90	12.50	12.05	12.05	12.05	12.00	12.00	12.00
Plates Chicago	$31.60	31.60	31.60	30.60	30.60	30.60	13.60	29.60	29.60	26.60	25.00	25.00
Billets (Bess.) Pittsburgh	$23.00	23.00	23.00	23.00	23.00	21.00	21.00	21.00	21.00	20.00	19.70	19.25
Bessemer Pig Pittsburgh	$15.90	15.90	15.90	15.90	15.90	15.90	15.90	15.90	15.90	15.39	15.10	15.15
Beams Pittsburgh	$28.00	28.00	28.00	28.00	28.00	27.00	27.00	27.00	26.40	24.00	22.60	23.25
Bar Iron Cleveland	$27.00	27.00	27.00	26.75	26.20	24.75	24.00	25.00	24.75	24.00	24.00	24.00
No. 2 Foundry Birmingham	$11.00	11.00	11.00	11.00	10.75	10.25	10.00	10.05	10.10	10.00	9.75	10.00

Charts based on above prices are published as a supplement of today's issue.